Student learning behaviours and clerkship outcomes

Lohuizen, Mirjam Tabita van

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Juli 2011

STELLINGEN

behorende bij het proefschrift Student learning behaviours and clerkship outcomes (Mirjam van Lohuizen, 13 juli 2011)

1. Wanneer bij longitudinaal beoordelen competentiegroei beschouwd wordt als wenselijke variatie, zijn er minder beoordelingen nodig om tot een betrouwbaar eindcijfer te komen. (dit proefschrift)

2. Er is geen verschil in klinische prestaties tussen coassistenten die een diepe dan wel een oppervlakkige leerstrategie hanteren. (dit proefschrift)

3. Een volledig beeld van het klinisch leergedrag krijgt men alleen door de competentiedomeinen kennis, vaardigheden en professioneel gedrag apart te bestuderen, ondanks dat de meeste leergedragingen door coassistenten in elk van deze domeinen gebruikt worden. (dit proefschrift)

4. Actieve coassistenten leren van hun ervaringen in de kliniek, passieve coassistenten ook. (dit proefschrift)

5. Het leergedrag van coassistenten laat zich beter beschrijven op het niveau van leerstrategieën dan op het niveau van persoonlijkheidseigenschappen.

6. Het concept "diep leren" blijkt ongeschikt om leergedrag op de klinische werkplek te beschrijven.

7. Wanneer coassistenten gestimuleerd worden tot ijver en tot initiatief in hun interactie met de omgeving, zullen zij het beter doen op de klinische werkplek.

8. De ideale docent kan dezelfde stof 10 keer uitleggen zonder in herhaling te vervallen. (vrij naar studenten VAG)

9. There is a sufficiency in the world for man's need, but not for man's greed. (M. Ghandi)

10. Wie in staat is een pittig artikel te schrijven, kan ook een goed gekruide stoofschotel maken.

Student learning behaviours and clerkship outcomes

Dissertation for the University of Groningen, the Netherlands, with references and summary in Dutch. The study presented in this thesis was carried out at the Graduate School for Health Research (SHARE) of the University of Groningen, within the program of Research in Medical Education (RME).

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Cover: Tjeerd van Sas, Niels van Velzen en Nikki Vermeulen
Press: Ridderprint BV, www.ridderprint.nl

ISBN 978 94 6070 040 8

cmb.

RIJKSUNIVERSITEIT GRONINGEN

Student learning behaviours and clerkship outcomes

Proefschrift

ter verkrijging van het doctoraat in de

Medische Wetenschappen

aan de Rijksuniversiteit Groningen

op gezag van de

Rector Magnificus, dr. E. Sterken,

in het openbaar te verdedigen op

woensdag 13 juli 2011

om 14.45 uur

door

Mirjam Tabita van Lohuizen

geboren op 19 april 1981

te Groenlo

Promotores:	Prof. dr J.B.M. Kuks Prof. dr J. Cohen-Schotanus Prof. dr J.C.C. Borleffs
Beoordelingscommissie:	Prof. dr F. Scheele Prof. dr P.L.P. Brand Prof. dr J.W. Snoek

Voor opa en opoe

Goed leren is juist voor meisjes belangrijk

CONTENTS

CHAPTER 1:
Introduction

General introduction

An important part of undergraduate medical training takes place in the hospital when students rotate through their clinical clerkships. It is at this clinical workplace that students need to integrate and further develop their knowledge, skills and professional behaviour in order to become autonomous and competent doctors.[1,2] The clinical workplace is a complex setting for learning because staff members and other health care professionals are faced with multiple tasks and competing demands in the areas of patient care, research and management, and clinical teaching.[3,4] Despite this complexity, recent research has shown that the major influences on clinical workplace learning can be retraced to 1) the learning environment, 2) student characteristics and behaviours and 3) the interaction between these two.[5-7]

The influence of the learning environment on clinical workplace learning has already been studied in a variety of settings.[5-7] Students perceive a clinical learning environment to be more conducive to their learning process if the department a) sets and communicates clear expectations to the students; b) facilitates an appropriate amount of both scheduled and informal opportunities for independent practice; and c) allows students to take part in

departmental routines.[7] In a department that provides a positive learning environment students felt they were seen and treated as team members and could participate accordingly.[5-7] Participation in the departmental routines contributes to a positive atmosphere and students perceive this as a good learning environment. In fact, in earlier studies student participation was reported as a major influence on the quality of clinical workplace learning.[5-7] These studies centred on the learning environment, but also reported that student characteristics and behaviours are important factors in establishing the level of participation.[5,7] However, it remains to be determined which individual differences affect clinical workplace learning. In this thesis, we have focused on medical students' learning behaviours during clerkships in relation to their learning outcomes.

Clerkship learning outcomes

We were interested in two types of clerkship learning outcomes: performance and wellbeing. Performance refers to the extent to which a student adequately executes his or her tasks. If performance is to be used as a research outcome, it has to be measured reliably. Therefore, the first step in our research, as reported in *chapter 2*, was to ascertain the reliability of the current

clerkship performance assessment. We subsequently examined the relation between students' scores in this assessment and their learning strategies (*chapter 3*).

The second clerkship learning outcome we studied is student wellbeing. A lack of wellbeing is considered undesirable, because a student who does not feel well is unlikely to be able to learn optimally.[8-10] Undesirable long-term outcomes that have been associated with a lack of wellbeing in undergraduate students are: a more negative attitude towards patients and increased burnout rates in residency.[9-11] An understanding of the factors affecting student wellbeing may lead to more effective, transferable prevention methods and consequently to more balanced professionals.[12] The influence of students' learning behaviours on their wellbeing has been discussed in several papers, especially in relation to the value of reflection and self-regulation.[11, 13-17] Empirical evidence explaining the causality between wellbeing and reflection and self-regulation is hard to find. As reported in *chapter 4*, we studied the causal relations between medical students' reflection and self-regulation, and their distress levels (lack of wellbeing); we did this both in the Netherlands and in several Scandinavian medical schools.

Describing and measuring clerkship learning

Early studies used qualitative methodology with small groups of students, such as think-aloud protocols and interviews, to find out how students in primary, secondary and undergraduate education learn.[18] With such qualitative methods it is possible to achieve a detailed description of each student's way of learning, however, these methods also take a lot of time per student. To enable quicker measurement of students' learning behaviours for large groups, the results from these qualitative studies were later on used to develop questionnaires. However, many of these questionnaires are context-specific. A review of adult learning concluded that the reliability and validity of such questionnaires is compromised when they are used in other settings.[18] Although suitable for multiple educational settings, most of the other – less context-specific – questionnaires were not intended for the workplace.[18,19] Their content often does not apply to workplace learning, which makes it hard for students participating in the workplace to complete them. This, in turn, may limit the validity of the results for these students.[19] Consequently, when studying workplace learning behaviours, the choice of questionnaire is critical. We used a thoroughly validated, specific workplace learning instrument,[20] but from the results of the first three studies we surmised that this questionnaire was not suitable

for describing clerks' learning behaviours after all. The question that therefore arose was: how could we then describe and measure clerkship learning behaviours?

Clerkship learning entails development in three domains of competence: knowledge, skills and professional behaviour.[1,2] Students' learning behaviours are likely to differ for these three domains.[21] We conducted a qualitative study, presented in *chapter 5*, to find out which learning behaviours medical students adopt during their clerkships in order to develop their knowledge, skills and professional behaviour.

We used the outcomes of this study to develop a questionnaire to measure students' clerkship learning behaviours (*chapter 6*). In this chapter we also report on the psychometric and practical properties of our questionnaire. In the final chapter, *chapter 7*, we discuss the meaning of all our results and provide methodological reflections, practical implications and suggestions for further research.

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CHAPTER 2:
The reliability of in-training assessment when performance improvement is taken into account

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Adv Health Sci Educ 2010;15:659–69.

CHAPTER 2

ABSTRACT

During in-training assessment students are frequently assessed over a longer period of time and therefore it can be expected that their performance will improve. We studied whether there really is a measurable performance improvement when students are assessed over an extended period of time and how this improvement affects the reliability of the overall judgement.

In-training assessment results were obtained from 104 students on rotation at our university hospital or at one of the six affiliated hospitals. Generalizability theory was used in combination with multilevel analysis to obtain reliability coefficients and to estimate the number of assessments needed for reliable overall judgement, both including and excluding performance improvement.

Students' clinical performance ratings improved significantly from a mean of 7.6 at the start to a mean of 7.8 at the end of their clerkship. When taking performance improvement into account, reliability coefficients were higher. The number of assessments needed to achieve a reliability of 0.80 or higher decreased from 17 to 11.

Therefore, when studying reliability of in-training assessment, performance improvement should be considered.

INTRODUCTION

It is well-known that a reliable overall judgement of clinical performance should be based on a combination of several assessments in order to avoid bias caused by, for example, case specificity or assessor variability.[1-6] Several studies have been conducted to estimate the number of assessments needed to achieve a reliable overall judgement.[1,7-10] An important question that remains unresolved is how, in longitudinal assessments, performance improvement can influence the overall judgement. In this study we examined performance improvement in in-training assessment and its effect on reliability.

Assessment of clinical performance

Clinical performance has often been assessed using the end-of-clerkship long case or Objective Structured Clinical Examinations (OSCE's).[2,8,10,11] Currently, these assessment methods are often supplemented or replaced by in-training assessments, consisting of multiple, structured and observed assessments of student performance in real health care settings.[6,12-15] In general, in-training assessments are done over a longer period of time than is common in long cases and OSCE's – for instance an entire clerkship.

Examples of in-training assessment methods are the mini-clinical evaluation exercise (mini-CEX), multisource feedback and clinical work sampling.[6,7,16,17] In-training assessments combining several methods to complement each other have also been described.[18,19]

Research on reliability of clinical performance assessments

Most methods for evaluating reliability of clinical performance assessments have in common that they estimate the amount of variance in student ratings considered relevant in relation to the amount of variance due to source(s) of 'noise' or error.[12,20] A reliability coefficient of 0.80 or higher is generally considered high enough for an overall judgement to be used in decision-making processes.[20] A comprehensive and widely used method for estimating reliability coefficients is the generalizability theory, which makes it possible to look at several sources of variance together.[20,21] With the generalizability theory it is also possible to estimate the number of assessments needed to achieve a reliable overall judgement.

When the traditional long case is used, it is hard to achieve a reliable overall judgement because it relies on a single assessment.[1,4,5] When OSCE's are used, a reliable overall judgement can be achieved when approximately 20 stations are included.[4,5,22]

Widely differing numbers of assessments needed have been reported for in-training assessments, ranging from 12 to 50.[6,19,23] However, from a recent review it becomes clear that in most contexts 8 to 14 assessments may be sufficient.[6]

Research questions

To date, reliability studies have considered performance differences between students as the only source of relevant variation. However, in-training assessment is usually done over an extended period of time,[6,12-14] so students can be expected to develop their competencies and, therefore, receive higher ratings in later assessments. That this actually happens has recently been shown in a study on an in-training assessment procedure in dentistry, where a learning curve was visible over the course of a year.[24] Consequently, performance differences within individuals over time can also be considered relevant to the concept of performance.[12,24] Higher ratings in later assessments then reflect actual (and desired) differences in performance over time rather than 'noise/error'. In this study we took these differences into account and formulated the following research questions:

- Is there a measurable improvement of performance when students are assessed over an extended period of time?
- If so, does this improvement affect reliability of the overall judgement and the number of assessments needed?

METHOD

Participants and procedures

After approval from the Clerkship Coordinators Committee, this study was conducted at the University Medical Center Groningen (UMCG), the Netherlands. Fifth and sixth-year medical students attended 14-week rotations in a range of disciplines at the UMCG or affiliated hospitals. The in-training assessment was a compulsory part of the students' clerkship assessment. We asked students for permission to use their assessment results from their concurrent clerkship. Giving permission was voluntary and on the basis of informed consent; anonymity was guaranteed. The average scores of participants were representative of the average scores of the student population at large.

In-training assessment method

By the end of 2005 a new, standardised in-training assessment procedure had been implemented at the UMCG and the six affiliated hospitals, an adapted translation of the mini-CEX.[7] All clerkship coordinators were involved in developing the assessment procedure and instrument. They reached consensus by discussion. Finally, six subjects were selected to be assessed: history taking, physical examination, case analysis/clinical reasoning, communication, organisation and efficiency, and professional behaviour. Furthermore, the lay-out of the instrument was changed in such a way that the assessors were forced to rate all items independently. The resulting mini-CEX form is presented in Appendix I. The assessors were asked to observe students during patient contacts, to provide formative feedback on each of the subjects (1 = insufficient to 5 = very good, room provided for written comments) and to provide a global rating for clinical performance on a 10-point scale (1 = completely insufficient; 5.5 = lowest pass; 10 = outstanding performance).

The interim assessments usually took place every two weeks, yielding a total number of 7 assessments per student. The mean of all global ratings was taken as the overall judgement; this overall

judgement was used in summative pass/fail decisions per clerkship. We assessed the reliability of this overall judgement.

Statistical analyses

In order to analyze whether performance improvement contributed to the course of the global ratings (first research question) three measures were used: t-test, growth curve and deviance test. A paired sample t-test (SPSS 14.0.2) was used to establish whether the differences between the first and last global ratings in the total group of students actually reflected a significant improvement. The growth curve and deviance test were obtained from the multilevel analysis discussed below. The growth curve is a plot reflecting the performance improvement of the 'average' student; combined with its confidence interval the growth curve provides another indication of the amount of improvement. Inspecting the deviance in multilevel models with and without performance improvement also helps determine whether performance improvement is a significant parameter.[25] The deviance is automatically reported in the output of most multilevel analysis computer programmes. Whether the improvement model has significantly better fit can be tested by taking the differences between the deviances of the models. This

difference is a Chi-square statistic, with degrees of freedom (df) equal to the number of parameter added.

To establish whether performance improvement affected reliability of the overall judgement and the number of assessments needed, we obtained reliability coefficients using generalizability theory. Generalizability comprises of two steps: the G-study and the D-study.[21,26] In our study, we have a one facet model, with student as object of measurement.

The first step is the generalizability study (G-study) in which the variance components associated with different sources of rating variation are determined.[21] We performed two G-studies: one ignoring performance improvement and the other taking performance improvement into account. The variance components were: differences between students, performance improvement (second analysis only) and 'noise/error'. In the traditional approach to reliability, the reliability coefficient can be derived through an analysis of variance with student as a factor.[27] However, in our study multiple assessments are 'nested' within students and are likely to show some correlation with each other. Therefore, we obtained the variance components through multilevel analysis, since this can adjust for those correlations.[28] Multilevel analysis also

was appropriate because it can account for differing numbers of assessments per student (unbalanced design), a problem often found in real-life data. Moreover, in multilevel analysis Maximum Likelihood estimation is used to estimate the variance components,[25,27] which is the suitable method for naturalistic data such as ours.[26] In the multilevel analysis level 1 represented the global ratings and level 2 represented students.[25] A random effects mixed multilevel model was the most appropriate.[27] We started with the empty model to obtain the variance components disregarding performance improvement and then added assessment moment to obtain the variance components taking performance improvement into account.

The second step in generalizability theory is the decision study (D-study) in which variance components obtained from the G-study are used to calculate reliability coefficients.[21] We first calculated relative reliability ignoring performance improvement, using Formula 1:

$$E(\rho^2) = \frac{\text{var}_{student}}{\text{var}_{student} + \text{var}_{other} / N_{assessments}}$$

Then we calculated relative reliability taking performance improvement into account, using Formula 2:

$$E(\rho^2) = \frac{\text{var}_{student} + \text{var}_{improvement}}{\text{var}_{student} + \text{var}_{improvement} + \text{var}_{other} / N_{assessments}}$$

$\mathbf{Var}_{student}$ represents the variance component associated with the differences between students, whereas the 'noise/error' variance component is represented by $\mathbf{var}_{other}$. In formula 2 $\mathbf{var}_{student}$ + $\mathbf{var}_{improvement}$ reflects the variation associated with student performance and improvement. The number of assessments is represented by $N_{assessments}$.

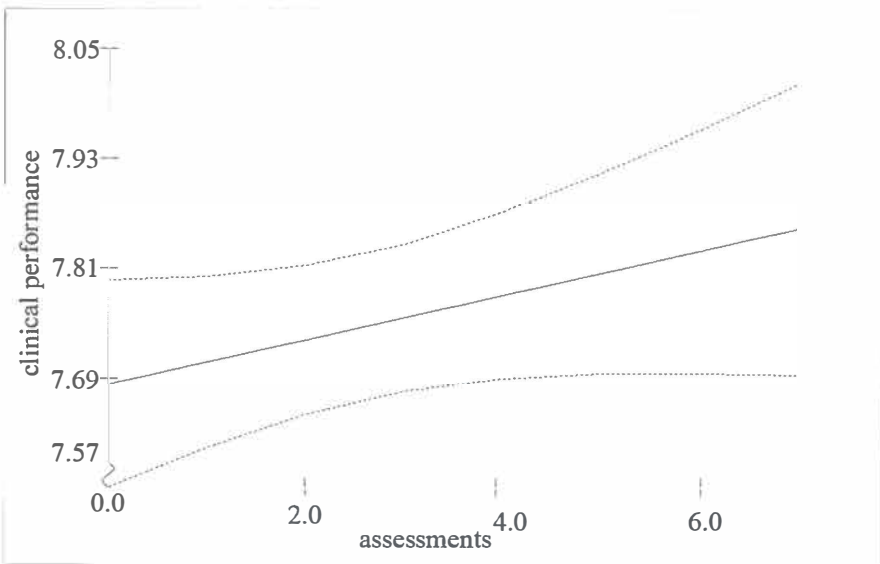
Finally we calculated the number of assessments needed to achieve a reliability of 0.80 in both situations.

RESULTS

In total, 574 global ratings were available for 104 students (75%). The mean number of assessments received was 5.5 (sd=2.2). The required number of 7 assessments was received by 55% of the students.

The overall judgement (average global rating) was 7.6 (sd=0.69) on the first and 7.8 (sd=0.60) on the last assessment, indicating a significant trend towards improvement (T=- 2.1, df=103, $p<0.05$). Figure 1 shows the average growth curve with its associated 95% confidence interval, also indicating a trend towards improvement.

Figure 1 Average growth curve with 95% confidence interval



Finally, comparing the deviance of the multi-level models showed that the model incorporating performance improvement fitted better with the data than the model not incorporating performance improvement ($Chi^2=11.10$, df=1, $p<0.001$), which indicated that performance improvement influenced reliability. Table 1 shows the variance components obtained through the multilevel analysis.

Table 1 Variance components obtained through multilevel analysis

1.a. *Improvement not taken into account*	
$var_{student}$	0.09
var_{other}	0.39
1.b. *Improvement taken into account*	
$var_{student} + var_{improvement}$*	0.13
var_{other}	0.35

*Including the covariance between student and improvement

The reliabilities of the overall judgments were calculated including all the assessments the students had. The reliability estimated for different numbers of assessments is presented in Table 2, along with the estimated number of assessments needed to achieve a reliability of 0.80. When performance improvement was taken into account, the reliability coefficients were higher. The number of assessments needed to achieve a reliability of 0.80 decreased from 17 to 11.

DISCUSSION

Student performance improved over the course of a clerkship. Taking this performance improvement into account led to higher reliabilities and the number of assessments needed to achieve a reliability of 0.80 dropped from 17 to 11.

Table 2 Reliability estimates for in-training assessments in undergraduate clerkships

Number of assessments	**1**	**2**	**5**	**6**	**7**	**11**	**17**
Improvement ignored	0.19	0.32	0.54	0.58	0.62	0.72	≥ 0.8
Improvement incorporated	X	0.43	→ 0.65	0.69	0.72	→ ≥ 0.8	→ →

Student performance was assessed over a 14-week period. At the beginning of the clerkship student performance was relatively high and it improved over the course of this period. This significant improvement was small, which might be caused by the usual

restriction of range found in clerkship assessment marks. Performance marks and pass rates are generally found to be high.[9,29,30] Therefore, only a few unsatisfactory or just sufficient marks are to be expected. In this small range of predominantly high performance marks, performance improvement is harder to show. This can be taken into account by using the formulae for relative reliability, as we did.[21]

These formulae showed that, taken performance improvement into account, the overall judgement gives a reliable ranking of the students, which is what is generally called for given the level these students have already achieved. Consequently, we do feel that the improvement we observed is meaningful.

Our results are also in line with an earlier study on in-training assessment of dentistry students. Longitudinal assessment over the course of a year yielded a learning curve.[24] This finding further supports our argument that performance improvement is a relevant factor to be taken into account when implementing longitudinal assessment.

We also asked how performance improvement influenced the number of assessments needed to achieve a reliability of at least 0.80. Earlier studies on in-training assessment differed in the

optimal number of assessments needed for a sound judgement of clinical performance.[6,19,23] Since these differences in number of assessments needed may be due to differences in assessment or study design, our results should be compared with those of studies using a similar design – including several hospitals and disciplines. The study by Alves de Lima et al. included multi-site implementation of the mini-CEX in cardiology residency training.[23] According to their results at least 50 assessments were needed to achieve a reliability of 0.80. In a study by Wilkinson et al. – focusing on combinations of in-training assessment procedures in residency training – the estimated number of assessments needed was 20 or more, depending on the specific combination of procedures.[19] Compared to these studies, the required number of assessments in our study, as estimated without taking performance improvement into account, was considerably lower. An explanation for this lower number of assessments needed might be that all students in our study shared a common pre-clinical curriculum and had to achieve the same exit qualifications. Both the pre-clinical curriculum and the exit qualifications were clear to clinical staff of all participating hospitals, which could reduce error due to different assessor expectations. This argument is also supported by the most recent multi-site, multi-discipline study, which was performed on in-

training assessment in the UK Foundation Programme.[31] All students had to meet the same curricular demands and assessment standards. In this study the number of assessments needed for a reliable outcome was also relatively low, no more than 12 assessments were necessary.[31]

When taking performance improvement into account our estimates became even lower: 11 assessments were necessary. The decrease from 17 to 11 assessments is particularly relevant from a practical point of view, because total assessment time is reduced by approximately a third. In our case an assessment would be needed almost every clerkship week, which is still quite often.

It could be argued that when in-training assessments are part of a comprehensive assessment programme, as is the case in our curriculum, reliabilities of 0.60 to 0.70 are acceptable, since assessment always involves compromises between reliability, validity and feasibility.[5,19,32] Still, there are ways to increase reliability without compromising the feasibility or the authentic nature of in-training assessment.

A first option is to gather more global ratings on students' clinical performance before the overall judgement is calculated. In our case, this could be done by assessing our students every week instead of

every other week. However, we know that our staff will be hard pressed to do so. Another possibility is that the overall judgement could be calculated after two rotations instead of one. Then students would have been assessed 14 times, which – based on the current data – should lead to sufficient reliability. Additional research is needed to confirm this expectation.

Another option might be using criterion-referenced assessment, for example using end-of-clerkship requirements as a criterion.[24] When students are judged relative to such a criterion, they will at first receive lower marks, since obviously most student will not have reached the end-of-clerkship requirements at the beginning of their clerkship. Later, marks will increase. In this way, criterion-referenced assessment allows for a greater variation in marks, which can make variation due to performance improvement more apparent. As a consequence, relevant variation in the marks is increased. Most methods for evaluating reliability of clinical performance assessments define reliability as the amount of relevant variance in relation to the amount of variance due to source(s) of 'noise' or error.[12,20] Increased relevant variation relative to 'noise/error' variation then implies a higher reliability coefficient. Therefore, we expect that the use of criterion-referenced assessment will lead to higher reliabilities and fewer assessments

will be needed. Further research is needed to confirm these expectations regarding criterion-referenced assessment, though. Our study raises the question whether there is a link between our findings on reliability and the subsequent summative decisions on clinical performance. In other words, when performance improvement influences reliability, it should be incorporated in summative decision making. This topic moves beyond the scope of our paper, but following this line of reasoning, the decision-making process about clinical performance should be reconsidered. Therefore, future studies should focus on how performance improvement can be incorporated in such a process.

A strength of our study design is that we collected assessment data from several hospitals and a range of disciplines. As a consequence, the results of our study are applicable to many different health care or clerkship settings.[33] A possible limitation of our study might be that not all students received the required 7 assessments during their clerkship. This was probably due to the relative novelty of the assessment procedure, causing students and teachers to sometimes forget the assessment. Besides, there was a delay between assessments being done and student administration receiving the results. The unbalanced design resulting from these missing data

can be dealt with by using multi-level analysis, as we did.[25] Another limitation might be that only the mini-CEX was used in the in-training assessment. Whether the same results would have been obtained with other methods of longitudinal in-training assessment – such as multisource feedback – has yet to be determined. However, since our line of reasoning applies to these other assessment methods as well, we would expect similar results when using any of these methods. A final limitation might lie in the study design: we did not employ an experimental setup to evaluate the reliability of our in-training assessment method. Such a setup would have yielded a more balanced design for use in the generalizability study and might have provided more information on possible factors (for example, assessor or case) contributing to the non-informative variation in the overall judgements. A more experimental setup, however, could not have revealed the same insight into the reliability of our in-training assessment method as it was used in everyday clerkship assessments.

Summarizing, accurately assessing student clinical performance remains a complex task, but in longitudinal assessment fewer assessments are needed than previously considered necessary, if performance improvement is taken into account. Students' clinical

performance improved over the assessment period and taking this performance improvement into account increased reliability. Further research should be conducted to replicate our findings in other settings or with other instruments and to examine our expectation that the use of criterion-referenced assessment can further reduce the number of assessments needed.

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Appendix I Adapted mini-CEX

Assessment of clinical performance [week and cluster]; [department]
[information on case and student, removed before data-entry]

Aspects mini-CEX		Feedback: illustration and advice
History taking - adequate interviewing - giving instructions - react to non-verbal signals and emotion	1* 2 3 4 5	
Physical examination - logical and efficient sequence - balances general and hypothesis driven examination - recognizes anomalies	1 2 3 4 5	
Clinial reasoning - Diagnosis based on knowledge and understanding - adequate use of diagnostics and tests - adequate interpretation data and formulation of policy plan	1 2 3 4 5	
Communication with patient - adequate explanation of diagnosis/treatment - gets consent, confers with patient -adequate written reports and case presentation - sufficient command of language	1 2 3 4 5	
Organisation & efficiency - adequate organisation - keeps the time, is concise	1 2 3 4 5	
Professional behaviour - shows respect - is involved and empathetic - generates trust in the patient	1 2 3 4 5	
Please provide written illustration with marks other than 3		

Clinical Performance**: 1 2 3 4 5 6 7 8 9 10

Signature:

* Feedback per subject: 1 = insufficient, 5 = very good
**Global rating of clinical performance: 1 = completely insufficient; 5.5 = lowest pass; 10 = outstanding performance

CHAPTER 3:
Learning strategies during clerkships and their effects on clinical performance

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Med Teach 2009;31:e494–e499.

ABSTRACT

Previous research revealed relationships between learning strategies and knowledge acquisition. During clerkships, however, students' focus widens beyond mere knowledge acquisition as they further develop overall competence. This shift in focus can influence learning strategy use. We explored which learning strategies were used during clerkships and their relationship to clinical performance.

Participants were 113 (78%) clerks at the university hospital or one of six affiliated hospitals. Learning strategies were assessed using the Approaches to Learning at Work Questionnaire (deep, surface-rational and surface-disorganised learning). Clinical performance was calculated by taking the mean of clinical assessment marks. The relationship between learning strategies and clinical performance was explored using regression analysis.

Most students (89%) did not clearly prefer a single learning strategy. No relationship was found between learning strategies and clinical performance.

Since overall competence comprises integration of knowledge, skills and professional behaviour, we assume that students without a clear preference use more than one learning strategy. Finding no

relationship between learning strategies and clinical performance reflects the complexity of clinical learning. Depending on circumstances it may be important to obtain relevant information quickly (surface-rational) or understand material thoroughly (deep). In future research we will examine when and why students use different learning strategies.

INTRODUCTION

The clinical workplace in which clerks have to develop their competences is complex and continuously changing.[1,2] As a result workplace learning is less structured than learning during the pre-clinical years, students are more able to influence their learning processes.[3] One of the ways students can influence their learning processes is by adjusting their learning activities.[4,5] The term 'learning strategy' is used for any cluster of related learning activities that students can use in reaction to a specific learning goal, assessment procedure or learning environment. In this study we explored which learning strategies clerks use and how these learning strategies relate to clerkship outcomes.

Three learning strategies are generally distinguished in undergraduate medical education: deep, strategic and surface

learning.[6] A deep learning strategy is characterised by students aiming for a thorough understanding, relating ideas from different sources and self-regulation. A strategic learning strategy is characterised by the attempt to achieve high grades while minimizing effort. Medical students who predominantly use the deep and strategic learning strategies have been found to receive higher examination marks.[7-9] The contrary is true for surface learning, which includes a lack of self-regulation and a tendency for rote learning.[10]

However, most of these studies on learning strategies were conducted in pre-clinical medical education and have focused on knowledge acquisition only. During clerkships, knowledge acquisition is still important, but students also need to develop their skills and professional behaviour in order to achieve an integrated whole: clinical competence.[11,12] This shift in focus is reflected in the assessment methods (for example mini-CEX or OSCE) used to determine the outcome of clinical training periods. Clinical assessments tend to be focused on clinical competence as a whole, rather than on assessing the separate components. As a consequence, students face a different learning content and an adjusted assessment procedure during clerkships in comparison with their pre-clinical training period. As argued in a recent review,

a change in learning content or assessment can change the learning strategies students use,[4] which indicates that the use of learning strategies during clerkships might differ from that during the pre-clinical training period.

This expectation is further supported by studies on workplace learning in general. Kirby and colleagues studied workplace learning in several different contexts and found that in the workplace the following distinction in learning strategies would be most appropriate: deep learning (elaboration, self-regulation and thorough understanding), surface-rational learning (structure, routine, memorisation of main issues) and surface-disorganised learning (lack of self-regulation, detailed memorisation).[13] The deep learning strategy they found is very similar to the deep learning strategy as it has been found in classroom learning. Surface-rational learning however, refers to an efficient combination of surface and strategic elements. Surface-disorganised learning finally, is mostly comprised of surface elements, combined with a deep sense of confusion.

However, we could neither find studies that addressed learning strategy use during clerkships nor studies concerning the way different learning strategies affect clinical performance. Therefore, our study was aimed at exploring students' learning strategies

during clerkships in order to provide more insight into the effectiveness of students' learning strategies in becoming competent doctors. As it is difficult to accommodate all learning strategies in a clinical curriculum, this insight can be informative when choosing effective teaching methods.[14] The following research questions concerning learning strategies were thus formulated:

1. Which learning strategies do medical students use during clerkships?
2. Do medical students have a preferred learning strategy in their clerkships?
3. Do different learning strategies have distinct relationships with clinical performance?

METHOD

Context

After obtaining approval from the Board of Teaching Directors, this study was conducted at the University Medical Center Groningen, the Netherlands. The medical curriculum in Groningen extends for six years. The pre-clinical curriculum is problem-based and patient-oriented, with clinical skills training mostly positioned in the third

and fourth year. In the pre-clinical phase knowledge is tested both immediately (course based assessment) and longitudinally (progress testing). Clerkships start in the student's fifth study year and consist of six 14-week rotations. The first four rotations, which students had to complete in fixed order, were studied: 1) internal medicine, 2) psychiatry and neurology, 3) surgery and oncology, and 4) obstetrics and gynaecology, and paediatrics.

Participants and procedures

The participants (n = 144) were students on rotation at the University hospital or at one of six affiliated hospitals. These students were asked to complete a learning-strategy questionnaire and for permission to obtain their rotation results. Granting permission was voluntary and confidential and anonymity was guaranteed. All participants received a gift certificate for their efforts. After combining the rotation results with the learning-strategy data, all identifying information was removed to ensure anonymity.

Measuring instruments

The Approaches to Learning at Work Questionnaire (ALWQ, Appendix I) was used to assess learning strategies.[13] We decided to

use the ALWQ because it was specifically developed for workplace learning and had been successfully applied before in a clinical setting.[15-17] The ALWQ assesses the extent to which each of three learning strategies is used: deep, surface-rational and surface-disorganised learning. The ALWQ consists of 30 items (10 per learning-strategy scale) which students have to rate on a five-point Likert scale (1 = hardly ever do this; 5 = almost always do this). Reliability as expressed in alpha coefficients is approximately 0.7 for each of the ALWQ-scales.[13,15,16] For the purpose of this study the ALWQ was translated into Dutch and then independently back into English to ensure the content of the questionnaire remained the same in the translation. The retranslation was approved by one of the developers of the ALWQ. When necessary, wording was adapted to clerkships, for example 'present job' was replaced by 'present rotation'. Students were asked to complete the ALWQ based on their learning behaviour during that current rotation.
To answer our questions we needed to determine the students' scores in two ways. First, a raw score per student was calculated for each learning strategy by taking the average score of that student on the 10 items belonging to the learning-strategy scale in question. These raw scores indicated the extent to which a student used each of the learning strategies. Second, we needed to determine which

learning strategy each student preferred. Based on earlier results with the ALWQ in a clinical setting[15-17] and our consultation with one of the developers, preference was defined as a student scoring higher than 3.75 on one learning strategy and lower than 3.25 on the other two. For example: a student who scored 3.8 on the deep scale, 3.2 on the surface-rational scale and 2.9 on the surface-disorganised scale was defined as having a preference for the deep learning strategy; a student who scored 3.8 on the deep scale, 3.6 on the surface-rational scale and 3.3 on the surface-disorganised scale was defined as not having a clear preference on any learning strategy. Clinical performance was assessed at regular intervals during the clinical rotations. The number of assessments during each rotation varied between five and seven times and at each time a different clinical teacher was involved. The clinical teacher observed the student interacting with a real patient and then rated the performance on the basis of a structured form containing key aspects of clinical performance. Each assessment was completed by providing an overall judgement of the student's clinical performance that could range from 1 (very low) to 10 (very good); in Dutch curricula 5.5 is the cut-off score for adequate performance.

The average of the overall judgements was taken as the indicator of the students' overall clinical competence (reliability approximately 0.70).

Analyses

Since the ALWQ had to be translated into Dutch, Cronbach's alpha reliabilities were calculated for each of the three learning-strategy scales. For basic correlational purposes, Cronbach's alpha should be around 0.60, Cronbach's alphas higher than 0.80 are advised for high-stakes decision making in educational or vocational testing.[18] We calculated descriptive statistics on student learning-strategy scale scores and learning-strategy preference. The relationship between learning strategies and clinical performance was assessed using univariate multiple regression analysis (SPSS 14). Learning-strategy scale scores were taken as independent variables and clinical performance as the dependent variable.

RESULTS

In total, 113 (78%) students participated in this study. After translation of the ALWQ, the reliabilities for the three learning-strategy scales (expressed in alpha coefficients) were: deep 0.50,

surface-rational 0.55 and surface-disorganised 0.65. The mean score for clinical performance was 7.8 (sd = 0.37), ranging from 6.7 to 9.0.

Learning strategy use

On average, students scored highest on the deep learning strategy (M = 3.45), followed by the surface-rational strategy (M = 3.25) and finally the surface-disorganised strategy (M = 2.45) (Table 1).

Table 1 Use of learning strategies
(1 = hardly ever do this; 5 = almost always do this)

Learning strategy	Mean (SD)	Range
Deep	3.45 (0.36)	2.8–4.3
Surface-rational	3.25 (0.40)	1.9–4.2
Surface-disorganised	2.48 (0.49)	1.4–4.0

Most students (89%) did not show a strong preference for a certain learning strategy (Table 2). Those who did, generally preferred the deep learning strategy, followed by the surface-rational learning strategy. None of the students had a preference for the surface-disorganised learning strategy.

Table 2 Preference[‡] for learning strategies & clinical performance assessment

Preferred learning strategy	Frequency (%)
No preference	101 (89)
Deep	9 (8)
Surface-rational	3 (3)
Surface-disorganised	0 (0)

[‡]Scored higher than 3.75 on this learning strategy and lower than 3.25 on the other two

Effect on clinical performance

The relationships between learning strategy scores and clinical performance were not statistically significant (Table 3), nevertheless the p-values for the surface-rational learning strategy (B=0.16, p=0.08) and the surface-disorganised learning strategy (B=-0.14, p=0.07) did approach statistical significance. The deep learning strategy had no effect on clinical performance (B=-0.03, p=0.75).

Table 3 Relationship between learning strategies and clinical performance

Learning strategy	B	sd(B)	β	T	p
Constant	7.76	0.49			
Deep	-0.03	0.10	-0.03	-0.32	0.75
Surface-rational	0.16	0.09	0.18	1.77	0.08
Surface-disorganised	-0.14	0.08	-0.19	-1.86	0.07

B = unstandardised regression coefficient
sd (B) = standard error of estimate B
β = standardised regression coefficient
T = t-test statistic associated with B and sd(B)
$R^2 = 0.04$ (n.s.)

DISCUSSION

In this study we explored the learning strategies used while developing competence during undergraduate clerkships. Most students (89%) did not have a preference for one learning strategy during their rotation, they used more than one learning strategy. Our study did not reveal any significant relationships between learning strategies and clinical performance.

The deep learning strategy was used most, followed by the surface-rational learning strategy and the surface-disorganised learning strategy respectively. This pattern is quite similar to that found in earlier studies.[15,16]

In clinical clerkships students need to develop knowledge, skills and professional behaviour simultaneously, resulting in the students having different learning goals at the same time. As argued in a recent review, different learning goals require different learning strategies.[4] This line of reasoning can explain our finding that most students used more than one learning strategy. It seems probable that students change their learning strategy depending on which aspect of competence they are focusing on. It could be argued that the deep learning strategy, with its emphasis on thorough understanding, is suitable for acquiring knowledge. For skills, however, the deep learning strategy would not be that useful. In fact, the surface-rational learning strategy would seem better, as it emphasises memorising protocol and working systematically (see also: Appendix I). This argument is further supported by the finding that students perceived to get different advice on how to learn for knowledge-based assessments than for skills-based examinations.[19]

The question remains as to why we did not find a significant relationship between learning strategies and clinical performance. As both structural knowledge and skills are needed to perform well in clinical practice, at least some relationship could be expected.

Finding no relationship between the deep learning strategy and clinical performance could be explained by the complex and presumably stressful nature of clerkships.[2,17] The deep learning strategy is probably not a good learning strategy in a time-pressured clinical workplace because there may not be enough time to undertake this learning strategy properly. The surface-rational learning strategy may be more suitable: the items in Appendix I show that this is a very systematic learning strategy. Students who are able to switch from one learning strategy to the other may benefit from this.[4] We indeed found a positive trend ($p < 0.10$) for the surface-rational learning strategy. The negative trend we observed for the surface-disorganised learning strategy can also be explained following this line of reasoning. Learning in a hectic environment requires students to find some structure. From the items in Appendix I it is clear that students who often use the surface-disorganised learning strategy are not able to do so.

At present we are conducting further research to examine whether students indeed adapt their learning strategies to the different aspects of competence and/or the demands of the hospital environment. In this study we will explore if, when, how and why students adapt their learning strategies.

A strength of our study is the clinical performance assessments used. These assessments were in line with recent literature advocating observed behaviour, a variety of patients and multiple examiners.[20,21]

Another strength of our design is that we gathered data from multiple sites and included multiple disciplines instead of a single discipline at a single site.[22] In our study most clinical disciplines were covered and clerks from both academic and non-academic settings were included. Therefore, it can be expected that our results can be generalized to most settings that medical students will encounter during clerkships at least in the Netherlands and likely in most western countries.

A possible limitation of our study is the restriction of range in the performance assessments (all students passed the exam). A restriction of range is typical for clerkship assessments[3,23,24] and reflects the fact that clerks are advanced students who are assumed to have been adequately trained. Nevertheless, some differences in performance are inevitable because some students will be better than others. As argued in the methods section, the assessments are reliable enough to distinguish these differences.

Another limitation might lie in the learning-strategy instrument we used. However, we did choose an instrument that was specifically

developed for workplace learning and had been applied successfully in a medical setting before.[15-17] Nevertheless, even after a careful translation process, the Cronbach's alpha reliabilities for the three learning-strategy scales were lower than those found in previous studies.[15,16] These lower reliabilities may influence the outcome of a regression analysis in two ways: 1) the low reliabilities might point to a problem with the validity of the factor structure in the translated version of the ALWQ questionnaire and 2) the lower reliabilities put a limit on estimated strength of any relation obtained through regression analysis.[18] As the absolute number of subjects relative to the number of items in the questionnaire preclude a proper check on the factor structure, we cannot fully exclude this explanation for the lack of relation between learning strategy use and clinical performance. However, given the close similarity between our data and that of earlier studies using the original version of the ALWQ, this does not seem to be the most likely explanation. Using a Spearman attenuation correction[18] to rectify the influence on the estimated strength of the relationship did not change the overall picture though, indicating that the lower reliabilities did not unduly influence our results.

In summary, most students seemed to use more than one learning strategy and we found no significant relationships between learning strategies and clinical performance. Using more learning strategies could be more efficient because overall clinical competence can be considered to entail the integration of knowledge, skills and professional behaviour and each of these aspects may require different learning strategies. The lack of a relationship between learning strategies and clinical performance may be explained by the complex and stressful nature of clinical learning. Further research will focus on if, when, how and why students use different learning strategies during clerkships.

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Appendix I Approaches to Learning at Work Questionnaire

no. ‡	*I. Deep*
1	The work I am doing in my present clerkship will be good preparation for other jobs I may have in the future.
2	In trying to understand a puzzling idea, I let my imagination wander freely to begin with, even if I don't seem to be much nearer a solution.
7	In trying to understand new ideas, I often try to relate them to real life situations to which they might apply.
8	I like to play around with ideas of my own even if they don't get me very far.
13	If conditions aren't right for me at work, I generally manage to do something to change them.
14	In my job one of the main attractions for me is to learn new things.
19	I find that studying for new tasks can often be really exciting and gripping.
20	I spend a good deal of my spare time learning about things related to my work.
23	I find it helpful to 'map out' a new topic for myself by seeing how the ideas fit together.
26	Some of the issues that crop up at work are so interesting that I pursue them though they are not part of my job.
	II. Surface-rational
4	When I am given a job to do at work I like to be told precisely what is expected.
5	I generally prefer to tackle each part of a task or problem in order, working out one at a time.
6	When I'm doing a piece of work I try to follow instructions exactly, even if they conflict with my own ideas.
10	I prefer the work I am given to be clearly structured and highly organised.
11	I prefer to follow well tried approaches to problems rather than anything too adventurous.

(continued on next page)

Approaches to Learning at Work Questionnaire (continued)

	II. Surface-rational (continued)
12	When I learn something new at work I put a lot of effort into memorising important facts.
16	I find it better to start straight away with the details of a new task and build up an overall picture in that way.
17	The best way for me to understand what technical terms mean is to remember the textbook definitions.
18	I think it is important to look at problems rationally and logically without making intuitive leaps.
22	I find I tend to remember things best if I concentrate on the order in which they are presented.
	III. Surface-disorganised
3	In this clerkship I find it difficult to organise my time effectively.
9	I prefer to have a good overview rather than focus on details.
15	The continual pressure of work – tasks to do, deadline, and competition – often makes me tense and depressed.
21	My habit of putting off work leaves me with far too much catching up to do.
24	Supervisors seem to delight in making the simple truth unnecessarily complicated.
25	Often I find I have to read things without having a chance to really understand them.
27	I certainly want to get good performance appraisal, but it doesn't really matter if I only just scrape through.
28	Although I generally remember facts and details, I find it difficult to fit them together into an overall picture.
29	I seem to be a bit too ready to jump to conclusions without waiting for all the evidence.
30	When I look back, I sometimes wonder why I ever decided to work here.

‡ Item numbers indicate the order in which the items were presented to the participants.

CHAPTER 4

Relationships between the concepts of distress, reflection and self-regulation in the training of medical students

Van Lohuizen MT, Lonka K, Nieminen J, Borleffs JCC, Kuks JBM, Cohen-Schotanus J.

ABSTRACT

Distress and burnout are major problems in medical education. Distress is a complex problem that is influenced by factors such as reflection and self-regulation. Several models to describe the relationships between distress, reflection and self-regulation can be derived from current literature, but there is no consensus on these relationships at the conceptual level. The aim of this study was to examine these conceptual relationships. Therefore, we conducted a multi-site study using different sets of instruments.

Scandinavian students (n=1010) filled in the MED-NORD questionnaire, with separate scales for distress, reflection and self-regulation. Dutch students (n=129) filled in the GHQ-12 (distress), the Groningen Reflection Ability Scale and the surface-disorganised scale (lack of self-regulation) of the Approaches to Learning at Work Questionnaire. Structural Equation Modelling was used to examine the causal relationships between these variables. These relationships were first tested in the Scandinavian data; the Dutch sample was used for replication.

Self-regulation and reflection positively influenced each other and negatively influenced distress. Higher distress, in turn, negatively influenced self-regulation and reflection. This fully

recursive model fitted best with the Scandinavian data as well as with the data from the Dutch participants (Scandinavian: Chi^2=6.05, df=7, p=0.53; CFI=1.00; RMSEA=0.00; ECVI=0.11; Dutch: Chi^2=100.8, df=26, p=0.02; CFI=0.95; RMSEA=0.05).

Of the four models we tested, a fully recursive model – in which distress, reflection and self-regulation were all recursively related – fitted best to both datasets. This model implies the possibility of a (vicious or virtuous) cycle. Both reflection and self-regulation can be trained and our results indicate that distressed students could benefit from such training.

INTRODUCTION

Many medical students and residents score higher on distress than the general population.[1-3] This is worrying, since higher scores on distress are associated with both personal and professional problems.[1-3] An understanding of the causes of distress is essential for the development of prevention methods. Distress is a complex problem that is influenced by different factors.[4] Two factors that are often discussed as being related to distress are students' reflection and self-regulation abilities.[5-10] It is unclear how these concepts are related. Knowledge of the relationships between distress, reflection

and self-regulation can provide a theoretical basis for interventions aimed at reducing distress. Such a theoretical basis, in turn, will make it easier to transfer successful interventions from one setting to another.[11] We examined the relationships between distress, reflection and self-regulation by studying these concepts in different (international) settings using two different sets of instruments.

The concepts of distress, reflection and self-regulation

At least 20 percent of residents and undergraduate medical students report distress or burnout and in some studies up to 80 percent of the participants are experiencing distress.[2,3] This high prevalence of distress is troublesome, because distressed residents are more likely to experience depression and suicidal thoughts and provide a lower quality of patient care.[12,13] Undergraduate clerks with higher distress have more trouble learning and show a more negative attitude towards patients.[14,15] Distress in undergraduate students can also be a precursor to burnout in residents, and this might eventually lead to loss of workforce over the years.[10]

In the social sciences, distress is considered a multifaceted phenomenon consisting of three related components:

1) environmental events (stressors), 2) mediating individual differences (such as personality, working habits or learning habits), and 3) the individual's reaction to the stressors (coping strategies).[4] In medical education, interventions to prevent or reduce distress usually focus on reducing stressors (component 1) or enhancing students' coping strategies (component 3), for example by making peer coaching mandatory or by teaching relaxation techniques.[11] The second component – mediating individual differences – is of interest as well, since longitudinal research indicates that these do indeed play a part in student distress.[10] Some students by nature experience more distress over the course of their training, while others seem to be relatively distress resistant.[10] Such differences may lead students to respond differently to an intervention, which could make such an intervention more effective for some students, but less effective for others. Examples of factors on which students may differ and that are thought to relate to distress are reflection and self-regulation, these were the focus of the current study.[5-10]

Students differ in the extent to which they are able and inclined to reflect on their behaviour and its causes and consequences.[5,6] In medical education, two modes of *reflection* can be distinguished: scientific and personal reflection.[7,8] Scientific reflection refers to

physicians' critical appraisal of literature and their own practice, and forms the basis for optimizing the degree of scientifically based clinical judgements. Personal reflection refers to the more affective and attitudinal aspects of reflection and is assumed to help with maintaining a balance between work, learning and self-care.[7,8] Personal reflection is a relatively stable , but not invariant factor in students' working and learning habits and it can be enhanced by training.[16] Taking the definitions of these two modes of reflection into account, we considered personal reflection of most interest when studying distress.

Students also differ in their ability to self-regulate. *Self-regulation* is high when students 1) learn by being active participants rather than passive recipients, 2) monitor, control and influence at least some factors involving their learning process (for example, by making a schedule for home-study), and 3) have a goal or criterion in mind against which they evaluate their learning process and its outcomes.[17,18] Students with greater capacities for self-regulation are more likely to have a better overview of what problems to anticipate and how to deal with them, [17,18] which may make them less susceptible to the adverse effects of stressors.

Relationships between distress, reflection and self-regulation: four plausible models

In current literature, theories on reflection and self-regulation sometimes lead to contradictory expectations on the relations between these concepts and distress. Some empirical studies have been done, but these are often hard to generalize, as they tend to be small or have been tailored to a particular problem or context.[11] Therefore, based on existing literature, there are four plausible models for describing the conceptual relationships between distress, reflection and self-regulation.

In the first model (*model one,* Figure 1a) reflection and self-regulation are independent predictors of distress. Reflection is assumed to help with maintaining a balance between work, learning and physical and mental health.[7,8] Students who score higher on reflection are therefore likely to experience less distress than students who score lower on reflection.[5-8] For the relationship between self-regulation and distress there is some empirical evidence: correlational studies found that self-regulation was negatively associated with both distress and burnout.[9,10]

The explanation in these studies was that self-regulated students are more organized, which could help them deal with or even prevent stressful events.

According to other authors, self-regulation and reflection are very closely related, to the point that reflection can be considered part of self-regulation.[19] This is incorporated in *model two* (Figure 1b), in which self-regulation is still a predictor of distress, but also a predictor of reflection. Any correlations between distress and reflection are assumed to result from their common cause self-regulation, not from a relation between the concepts themselves.

Another view on the close relation between reflection and self-regulation is that these aspects consistently occur together in successful learners, making it hard to distinguish between the two.[5,9] In this viewpoint, reflection and self-regulation are separate concepts and both are needed to achieve success in learning.[5 7,9] The continuous interaction between reflection and self-regulation that is the core of this viewpoint, implies a recursive relationship, as depicted in *model 3* (Figure 1c), with reflection and self-regulation as related predictors of distress.

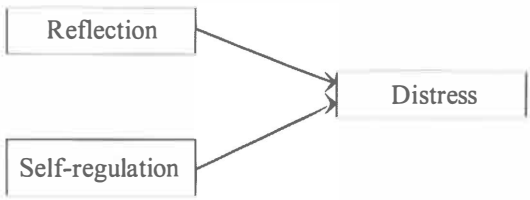
Apart from the relations between reflection and self-regulation, the causality between distress on the one hand and reflection and self-regulation on the other also is not entirely clear. While low reflection and self-regulation may lead to more distress-experiences, it might just as well be that students with higher distress are so affected by this that it influences their ability to reflect or self-regulate. That this is at least plausible was shown by a longitudinal study in which students who started out with higher distress later developed less self-regulating work habits.[10] The authors suggested that there could even be a vicious cycle of decreasing self-regulation leading to increased distress, in turn leading to decreasing self-regulation, and so on.[10] In *model 4* (Figure 1d), therefore, all relationships are shown as recursive.

Several methods exist to measure distress, reflection and self-regulation. According to a recent review on efforts to reduce distress, differences in the measurement methods used in studies on distress-reducing interventions make it hard to generalize the effects of the interventions from one setting to another.[11] For a study to result in transferable knowledge, the relationships found have to hold at the conceptual level and be independent of context and measurement method. Therefore, we conducted two studies, one in

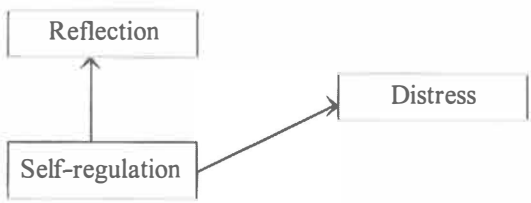
Scandinavia and the other in the Netherlands, each employing a different set of measurement methods to provide an empirical and conceptual test of the models in Figure 1.

Figure 1 four plausible models of distress, reflection and self-regulation

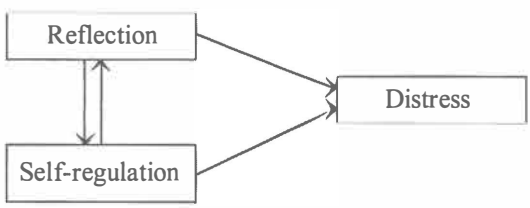
1.a: *reflection and self-regulation as independent predictors of distress*



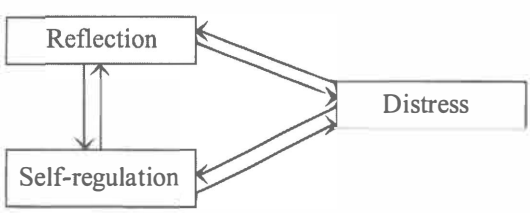
1.b: *self-regulation as predictor of both reflection and distress*



1.c: *reflection and self-regulation as related predictors of distress*



1.d: *reflection, self-regulation and distress influence each other recursively*



METHOD

Data collection

Scandinavian data

The Scandinavian students were 673 Finnish and 344 Swedish medical students from eight medical schools. Ethical approval procedures varied according to local policy, but at all locations participants signed identical forms giving their informed consent. Participation was voluntary at all locations. The eight medical programmes varied considerably, with two of the eight curricula being problem-based (one Swedish and the other Finnish). All Scandinavian participants filled in the MED NORD questionnaire.[9] This instrument contains separate validated and reliable scales for distress (from Elo et al.), self-regulation (from Vermunt and Van Rijswijk) and personal reflection (from the Conceptions of Learning and Knowledge Questionnaire).[22-24] Distress and self-regulation are measured on a five-point Likert scale, reflection on a six-point Likert scale.

Dutch data

Under Dutch law, educational studies are exempt from Institutional Board Review. We discussed the proposal with the Board of

Teaching Directors to ensure no harm could come to the participating hospitals or individual participants. We also used published ethical standards to guide the research procedures.[24,25] Participation was voluntary and confidential, and all data were anonymized before analysis. The Dutch students (n=144) were on rotation at the University hospital or at one of the hospitals affiliated with the University Medical Center Groningen. They were following a six-year, problem-based, patient-oriented curriculum, with six rotations lasting 14 weeks each. The Dutch participants completed the surface-disorganised scale (measuring lack of self-regulation) of the Approaches to Learning at Work Questionnaire (ALWQ, based on the theory of Entwistle and Ramsden), the Dutch translation of the GHQ-12 (a screening tool to detect whether one is likely to have psychiatrically problematic distress levels) and the Groningen Reflection Ability Scale (GRAS, specifically designed to measure the level and development of reflection in medical settings).[16,26,27] All these questionnaires had been validated before.[16,26,27] Both the ALWQ and the GRAS measure on a 5-point Likert scale, the GHQ-12 measures on a 12-point Likert scale. Scores on the ALWQ surface-disorganised scale were reversed to indicate amount of self-regulation.

Even though the instruments we used in the Scandinavian and Dutch studies were developed from different perspectives, they purport to measure the same concepts. Therefore, they are suitable for studying the relationships between distress, reflection and self-regulation at the conceptual level, irrespective of nationality and instruments.

Analyses

We calculated zero-order correlations to ensure that distress, self-regulation and reflection were indeed related in both datasets. The four models that were plausible based on literature were then tested with Structural Equation Modelling (SEM), using the Lisrel 8.8 programme.[28,29] Before analysis, missing data were deleted listwise. In the Dutch dataset the ratio of participants to items approached 1:1, which could yield estimation problems. [28,29] This was solved by using item-parcels instead of raw item scores.

The GRAS has three underlying facets: self-reflection, empathetic reflection and reflective communication, these were used as the item-parcels for the GRAS. For the other two Dutch questionnaires, no such factors are known. Here we constructed item-parcels based on the correlations between the items, with each parcel containing 2 items.

We started our analyses by examining the four models in the Scandinavian dataset. To determine the best model, we first determined which models were representative of the data (had appropriate fit). The criteria for the fit indices are: chi-square non-significant, a comparative fit index (CFI) over 0.90 and a root mean square error of approximation (RMSEA) below 0.50. Ideally these criteria should be met conjointly.[28] If a model does not fit well, the Lisrel programme provides suggestions for changes to increase the fit between the model and the data. These changes should only be made if the suggestions are in line with existing literature or study design.[28,29]

When more than one model has an adequate fit with the data, the second step to determine the best model is to look at the single-sample cross-validation index (ECVI). The model with the smallest ECVI-value is considered best. After obtaining the best fitting model for the Scandinavian data, we performed a replication study on that model using the Dutch data.

RESULTS

Full data (answers on all variables) were available for 1010 Scandinavian (99%) and 129 Dutch students (90%). In both datasets, self-regulation and reflection were significantly positively related to each other and significantly negatively related to distress (Table 1).

Table 1 Zero-order correlations between distress, self-regulation and reflection

		self-regulation	reflection
Scandinavian	distress	-0.38**	-0.07*
	self-regulation	1.00	0.15**
Dutch	distress	-0.31**	-0.16*
	self-regulation	1.00	0.43**

* $p < 0.05$; ** $p<0.01$

Model 4 was the best model for the Scandinavian students' data. This model had an appropriate fit and the smallest ECVI (Table 2). In *model 4*, distress was both cause and consequence of students' reflection and self-regulation. Reflection and self-regulation, in turn, both had recursive causation as well. The path diagram belonging to this model is presented in Figure 2. The effect of self-regulation on distress was larger than the effect of reflection.

Table 2 Fit-indices for Scandinavian data; best model in bold

fit-index	Chi-square (df, p)	CFI	RMSEA	ECVI
criterion	n.sig	>0.90	<0.05	smallest
model 1	0.84 (11, 1.00)	1.00	0.00	0.16
model 2	6.87 (10, 0.55)	1.00	0.00	0.16
model 3	12.17 (9, 0.10)	0.98	0.05	0.15
model 4	**6.05 (7, 0.53)**	**1.00**	**0.00**	**0.11**

Table 3 provides the fit indices for the first run of the fully recursive model (theoretical *model 4*) in the Dutch data. The values for CFI and RMSEA were in line with the criteria, but Chi-square was significantly different from zero. Some modifications were necessary to fit *model 4* to the Dutch data.

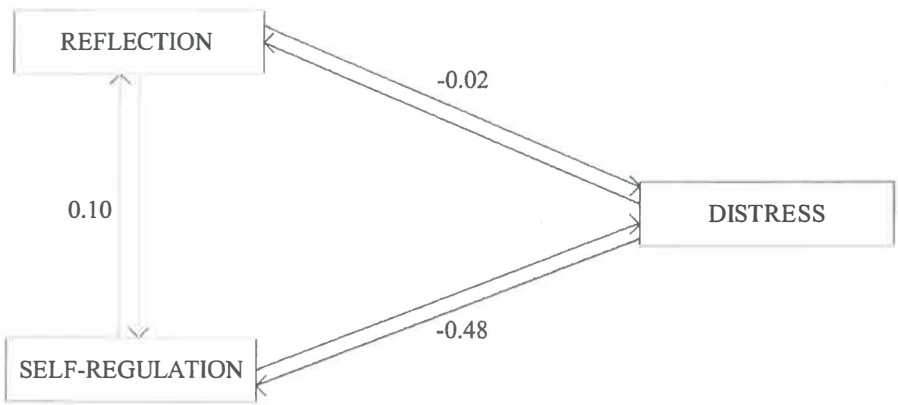
Table 3 Fit-indices model 4 for Dutch data

fit-index	Chi-square (df, p)	CFI	RMSEA
criterion	n.sig	>0.90	<0.05
model 4, first run	122.83 (24, <0.001)	0.91	0.06
model 4, after modifications	100.08 (26, 0.02)	0.95	0.05

Two of the modification suggestions made sense theoretically: allowing two item-parcels for self-regulation to correlate and

allowing two item-parcels for distress to correlate. The results of this second run are shown in Table 3 as well. This slightly modified version of *model 4* was an adequate description of the relationships between distress, reflection and self-regulation in the Dutch data. Here too, all variables were both cause and consequence of the other variables.

Figure 2 Path diagram with fully recursive relationships between distress, reflection and self-regulation (Scandinavian data)



DISCUSSION

In this study we analysed the conceptual relationships between distress, reflection and self-regulation. On the basis of existing literature, four different models seemed plausible. We conducted two studies in different countries and found that, out of these four

models, the relationships between distress, reflection and self-regulation were best described by a recursive model (theoretical *model 4* in Figure 1). In this model, distress can be both cause and consequence of students' reflection and self-regulation, while reflection and self-regulation are also cause and consequence of each other.

In this study we focused on differences between students that can make them more or less susceptible to distress-provoking situations and that thereby influence the amount of distress they experience. The results indicate that reflection, self-regulation and distress are recursively related, which raises the possibility of a vicious or virtuous cycle. The *vicious cycle* could ensue from, for instance, high distress that leads to low reflection or self-regulation, which, in turn, leads to even higher distress, and so on. The *virtuous cycle*, or positive spiral, could be achieved when high reflection or self-regulation leads to a decrease in distress, allowing increased time and attention for reflection and self-regulation, which in turn leads to even lower distress, etcetera.

Our findings indicate that an intervention to reduce distress may be successful if any of the three variables (distress, reflection or self-

regulation) are targeted. However, interventions targeting two or more of these variables at once may be more effective, as the effects are likely to strengthen each other. As a result, when the effects of a distress-reducing intervention are studied alongside a programme change emphasizing reflection or self-regulation, the two may reinforce each other. Such reinforcement between intervention and training programme therefore might yield greater gains than the intervention on its own. This might explain why the results of successful interventions are often so hard to generalize.[11] One should bear in mind though, that the relation between reflection and distress is quite small. Therefore, if one want to target any of these variables in an intervention, we would recommend targeting self-regulation.

A possible explanation for the small relation between distress and reflection could be that these concepts only influence each other through self-regulation. This is somewhat similar to model two, but in model two only a one-way causality between all variables is assumed, whereas recursivity seems more plausible, based on our studies. Considering our fit criteria (chi-square non-significant, comparative fit index over 0.90 and root mean square error of approximation below 0.50), the fit of the recursive model was better.

Also, the single-sample cross-validation index was lower, indicating that the recursive model is a more appropriate description of the data from our students. A recursive relation between self-regulation and reflection on the one hand and between self-regulation and distress on the other, without a direct relation between self-regulation and distress, did not seem very plausible on the basis of existing literature. However, when we combine existing literature with our findings it seems a logical alternative to the models in Figure 1. We did not have sufficient participants to test this fifth model, so further research is needed to see whether a recursive, but not fully cyclic model, would indeed be more representative of the relations between distress, reflection and self-regulation.
Apart from the bigger effect size, the positive effect of self-regulation is also in accordance with earlier studies, in which the use of a learning strategy highly reliant on self-regulation (deep learning) was related to perceived workload as well as burnout.[10,30]

The main strength of our study is the international, multi-site design, which allows generalization of our findings at least to the Northern European population of medical students. The SEM analyses allowed us to the test the same model with both Scandinavian and Dutch students, because with SEM one estimates

both the measurement error and the concepts under study separately and then calculates the relations between the underlying concepts irrespective of the measurement error. The second strength is the use of different instruments to measure the same concept. Even with these different instruments we found very similar correlation patterns, indicating that we indeed studied the relationships at a conceptual level, independent of the measurement used. A possible limitation is that our study relies on non-experimental self-report. However, a more experimental approach would have been impractical, since we focused on differences between students that are hard to measure more objectively. The least subjective alternative would be independent observation by multiple observers, but this was not feasible given the number of participants needed to perform the SEM analyses. Another limitation is the sample size in the Dutch study, which made it necessary to use item-parcels instead of raw item scores. However, according to general rules of thumb, the number of Dutch participants were high enough for the analyses we performed.[28] Future research could employ a larger sample to replicate and confirm the relations between distress, reflection and self-regulation in other Dutch and broader international settings.

In conclusion, of the four plausible models based on literature, the recursive model fitted best to the relationships between distress, reflection and self-regulation. This conceptual model was confirmed in both the Scandinavian and the Dutch data. This indicates that future interventions to reduce distress might benefit from an approach in which reflection and – in particular – self-regulation are included. However, the relation found between distress and reflection was small. Therefore, we suggest to investigate the logical next model – a fifth model with only recursive relations between self-regulation and reflection and between self-regulation and distress.

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CHAPTER 5:
Learning behaviours students report in a clinical setting

Van Lohuizen MT, Boendermaker PM, Kuks JBM, Briët JW, Borleffs JCC, Cohen-Schotanus J.

ABSTRACT

In clerkships the emphasis of learning shifts from knowledge acquisition to the integration of knowledge, skills and professional behaviour. This change may require clerks to adjust their learning behaviours to make the most out of their clerkship learning experiences. In the current study we explored which learning behaviours students adopt during clerkships.

Fourth-year medical students at the end of their third rotation were interviewed about learning behaviours used for developing knowledge, skills and professional behaviour. Themes were explored by analysis of co-occurring codes, comparing codes between different domains of competence and analysis of similarities and differences between students. Member checking, constant comparison and consensus discussions were used to confirm emerging themes.

After interviewing 11 students, saturation was reached. The interviews yielded 31 different learning behaviours. Some learning behaviours were reported exclusively for knowledge, skills and professional behaviour, but many learning behaviours were used in multiple domains. The learning behaviours could be categorized into: 'disengaging behaviour', 'waiting to be involved', 'learning

from obligations', 'independent accumulation of knowledge' and 'taking initiative in clinical practice'.

Students reported a range of active and passive learning behaviours which also seemed to be influenced by their involvement in the learning environment. The current overview fits with existing educational theories on workplace learning and provides a solid base for the development of a new clerkship learning questionnaire.

INTRODUCTION

Within a medical curriculum there can be a difference between learning behaviours in the pre-clinical phase and in the clerkships.[1] This is because the emphasis of learning shifts to integration of knowledge, skills and professional behaviour with the ultimate goal of achieving overall clinical competence.[2,3] In the current study we explored which learning behaviours students adopt during clerkships.

Nowadays research on undergraduate clinical learning is not only focused on clerks' acquisition of theoretical knowledge, but also on training of skills and professional behaviour.[4-6] Knowledge may be

mastered individually – for example from books – but complete mastery of skills and professional behaviour requires real-life practice in a team at the clinical workplace and this calls for a socio-cultural, participatory view on the clinical learning process.[6,7]

According to participatory learning theories, clerks develop their competence by taking part in authentic tasks within the clinical workplace.[6,8-10] These tasks should be relevant to the daily work to be done by the team, but on the other hand they should be sufficiently distinguished from the core responsibilities of the team that there is no risk of problems in the care for patients.[6] Such tasks are called *legitimate peripheral tasks*. Depending on the competence of the student, these tasks can range from observing a consultation to independently handling a physical examination and even performing a complete consultation under supervision. The tasks to be performed should be increasingly difficult and more central to practice, to enable students' learning to deal with difficult situations that will occur during their clinical work.[6,8,9]

The interaction between the learning environment and the students is crucial for an optimal clerkship learning process.[8,9] The learning environment consists of all people and resources students can turn

to for support in their learning. In the clinical workplace, learning can be enhanced by a) making expectations clear to the students, b) offering a range of formal and informal learning opportunities and c) allowing students to take part in departmental routines.[11,12] On the other hand students themselves enhance clinical learning by learning behaviours they adopt.[4,6,13,14] Until now it has been difficult to identify the most effective workplace learning behaviours.[1,4] This might be because questionnaires used were mainly focusing on cognitive learning at the workplace[1] while social and participatory aspects of clerkship learning were rarely covered.[7,14] In the current study we further inventoried the learning behaviours students use during clerkships, with special attention to the training of skills and professional behaviour, in order to be able to the effectiveness of learning strategies in future studies.

METHOD

Participants and context

Participants were students from the first master's year of the UMCG-curriculum. This curriculum, with about 400 students per year, consists of a three-year Bachelor's programme with competency-based, patient-centred education and limited skills

training followed by a three-year Master's programme. The Master's programme mainly consists of clinical rotations and a six-month research project in the final Master's year.
This first Master's year comprises four junior rotations of 10 weeks with dual learning at the skills lab and clinical wards. We invited students from 4 successive groups at the beginning or their third junior rotation. A selection was made to include students supposed to have divergent learning experiences based on their gender, cultural or educational background. New students were invited until saturation was reached, i.e. no new learning behaviours were reported in the interviews.

Under Dutch law educational studies are exempt from ethical institutional board review. We used published ethical standards to guide the research procedures.[15,16] Participation was voluntary and confidential. To warrant anonymity, all data were separated from personal information before analysis.

Interview and analysis procedure

The interview procedure was based on the outline for in-depth interviews described by DiCicco-Bloom and Crabtree.[17] Details on the exact procedure we followed can be found in Box 1. The

interviews were carried out by a medical doctor emeritus (JWB) with more than twenty years experience in training clerks. After obtaining consent from each participating student, the first author observed the interviews and took notes. At the end of an interview the student received a gift certificate.

Since we wanted students to describe the full range of their learning behaviours rather than only focusing on knowledge, we asked them to bring up an example of a learning experience within three domains: knowledge, skills and professional behaviour. The three examples per student provided input for one-hour semi-structured interviews, with the following items as guideline for the interviewer in exploring each example:

- Describe the situation: who were involved, which location, et cetera
- Describe the learning task that was dictated or set by yourself
- Describe the activities you undertook to perform that task
- Describe the results of those activities.

Items one, two and four of this itinerary were used to provide the context so that the students could more easily recall their activities.

Item three was the item of interest for answering the research question and was intended to provide the information to be analysed. The interviewer allowed the student to choose the domain to start with.

Box 1 interview procedure

E-mail with appointment + request to bring examples of learning situations
- Knowledge, skills & professional behaviour asked separately

Stimulated recall (audio recorded)
- Describe example and context
- Identify learning task
- Explore learning behaviours
- Make sure student has nothing to add.
- Approximately 1 hour

Altered itinerary
- To balance amount of information for each domain
  - First interviews students' reports focused on knowledge and skills; in later interviews more time was reserved for explicit questions on learning behaviours regarding professional behaviour.

The analysis followed the procedures outlined by Miles and Huberman (box 2).[18]

Results of earlier interviews were used to adapt the itinerary or focus of later interviews (see box 1).[17,18]

Box 2 data analysis

Interview summarised
Summary checked by participant
= 'member checking'[19]; to prevent researcher bias

Transcription of interview entered in Atlas.ti[20]

Initial coding (2 interviews) by MvL
Selection of interview segments pertaining to the research question
Coding the learning behaviours in that segment
Consensus discussion all authors on initial coding framework

Each interview coded by MvL and one of the co-authors
Independent selection of interview segments pertaining to the research question by both coders
Independent coding of the learning behaviours in that segment by both coders
Consensus discussions between two coders
Changes in coding framework and unresolved differences discussed with all authors

Constructing framework of clerkship learning behaviours
Reading of fragments relevant to the research question
High-frequency codes
Co-occurring codes
Similarities and differences between students
Similarities and differences between knowledge, skills and professional behaviour.
Constant comparison of emerging results with full transcripts, summaries and observer notes
Revision of emerging themes and relations
Consensus discussions with all authors on analysis process, themes and disagreements
Final framework checked against full transcripts and discussed with all authors.

CHAPTER 5

RESULTS

Thirteen students were interviewed. After 11 students saturation was reached, that is, no new learning behaviours were reported in or after the eleventh interview. In total the thirteen interviews we analysed contained 31 different learning behaviours (Figure 1).

Some learning behaviours were exclusively reported in the context of knowledge acquisition, others in relation with training of skills or developing professional behaviour; for example *developing a coping strategy* was only reported when students discussed their learning related to professional behaviour. Other learning behaviours were reported for more than one competency domain by individual students or for different domains by different students. Examples are *practising continuously* and *observing*, which were reported for the development of both skills and professional behaviour, and *asking questions*, which was reported for all three domains of competence.

Some learning behaviours were exclusively reported in the context of knowledge acquisition, others in relation with training of skills or developing professional behaviour.

Figure 1 Reported behaviours adopted to learn in clerkships, grouped according to five themes

Passive learning behaviour	Active learning behaviour
disengaging learning behaviour	independent accumulation of knowledge
avoiding *keeping quiet* *sticking to hours*	*home studying* *searching for information in books*[1] *searching for digital information*[1] *taking notes*[1]
waiting to be involved	taking initiative in clinical practice
asking questions after encouragement *waiting for explanations* *waiting for feedback* *waiting for opportunities*	*applying* *asking for feedback* *asking for opportunities* *asking questions* *confronting*[3] *developing coping strategy*[3] *discussing problems & difficulties*[3] *facing clinical problems* *linking to previously learnt* *monitoring information quality*[1] *practising continuously* *preparing* *reflecting* *taking initiative* *talking about experiences*[3] *trying out*
learning from obligations	
following instructions[2] *observing* *practicing at officially scheduled times* *taking orders*	

1) reported only for knowledge; 2) reported only for skills; 3) reported only for professional behaviour; no number: reported for at least two domains of competence.

For example *developing a coping strategy* was only reported when students discussed their learning related to professional behaviour. Other learning behaviours were reported for more than one competency domain by individual students or for different domains by different students. Examples are *practising continuously* and *observing*, which were reported for the development of both skills and professional behaviour, and *asking questions*, which was reported for all three domains of competence.

From students' reports two main themes emerged into which all learning behaviours could be categorized: passive and active learning behaviours. We classified learning behaviours as passive if the learning behaviours did not require any initiative on the part of the student. Active learning behaviours were those for which the students had to take initiative. Within the passive learning behaviours, three subthemes emerged: 'disengaging behaviour', 'waiting to be involved' and 'learning from obligations'. Within the active learning behaviours two subthemes emerged: 'independent accumulation of knowledge' and 'taking initiative in clinical practice'.

Disengaging behaviour

Students sometimes perceived their learning environment as discouraging. For some students this discouraging environment led to disengagement. Associated behaviours were *avoiding* your supervisor and *keeping quiet*. To cope with the situation students also tried to *stick to* their scheduled *hours*.

> Clerk 4: "After my supervisor had told me off that harshly, I figured I'd better keep quiet. I found it really hard to go to him and ask him anything after that incident."

Waiting to be involved

This theme included a wait-and-see attitude, which could be distinguished in three different learning behaviours: *waiting for opportunities* to function independently, *waiting for explanations* and *waiting for feedback*. Students also waited to *ask questions after encouragement*.

> Clerk 5: "At first I was nervous to ask questions, but then the supervisor stayed a bit longer and encouraged me to ask something. And after that I dared to ask something."
> Clerk 11: "At 1 p.m. all clerks have to present their patients to the residents and at that scheduled meeting you get quite some feedback. The residents and other clerks also ask a lot of questions, which gives you the opportunity to practise things like recognizing signs and symptoms of an illness, or suggesting a treatment."

Learning from obligations

The theme 'learning from obligations' concerns the daily duties of any clerk like *observing* daily practice, strictly *following instructions*, gaining experience by *taking orders* from staff and *practising at officially scheduled times*.

> Clerk 2: "I observe how a doctor or resident manages the outpatient clinic. I don't really do anything myself, I just sit and watch. I learn a lot that way."

Independent accumulation of knowledge

These learning behaviours generally took the student away from the workplace. When students ran into something interesting or new at the workplace, they used *note taking* to get back to it later. Subsequently, they *searched for* the information they needed *in books* or *digitally*. This information was regularly available at the workplace, but most of the time the students searched at home.

> Clerk 3: "In the clerkships I run into lot of things that make me wonder. This happens, for example, while observing a doctor-patient consultation. I just make notes and later I search for the information I need, for example on the internet or in a book."

Taking initiative in clinical practice

Students' active attitude in workplace learning was visible in the way they communicated about their learning needs as well as the way they approached their daily clerkship tasks.

Students communicated their learning needs to their supervisors by adopting the learning behaviours *asking for feedback*, *asking for opportunities*, *asking questions* and *confronting*.

> Clerk 5: "How much you learn from supervision largely depends on yourself. You have to be on top of it and just ask for anything you need. At least, that's what I do."

The learning behaviours 'asking for feedback' and 'asking questions' were mainly used to get more information on the quality of work and suggestions for improvement. The other learning behaviours students used to communicate their learning needs – 'asking for opportunities' and 'confronting' – were mainly used to get the chance to improve through practice. 'Confronting' – making clear that learning needs were not met and discussing how to improve this – was only used when students perceived the learning environment as discouraging. According to the students who reported this learning behaviour, 'confronting' initially was not meant to learn, but to address some unprofessional behaviour in their learning environment. Only afterwards they realized that 'confronting' had been a learning behaviour too, giving them insight into their own view of professional behaviour and how to communicate it.

> Clerk 6: [with respect to often being explicitly excluded from departmental activities] "I could have done several things. I could have accepted the situation, thinking 'I'll be out of here in

> a couple of weeks'. I could have opposed, but that could have made things worse. Finally, I just confronted them and said 'I want to talk this through'. That worked well."

The theme 'taking initiative in clinical practice' also covered learning behaviours like *talking* with supervisors and peers *about experiences* and *discussing problems and difficulties*. Students used these learning behaviours to process their workplace learning experiences more thoroughly.

> Clerk 1: "Of course there are small group meetings for discussing our experiences and scheduled themes, but then smaller issues are not put forward. But before and after those meetings, everybody talks about these things. For example, how you should address a patient."

Other learning behaviours the students reported for processing their learning experiences were: *developing* a *coping strategy* to deal with difficult situations; *monitoring* the *quality* of any tips and *information* they found themselves or got from their supervisors; *linking* these tips and information *to* what they had *learnt previously*; and *reflecting* independently on their functioning and development. An example of the latter:

> Clerk 9: "In the rehabilitation department, we could record our patient interviews on video, after patient permission of course. Afterwards, there was the opportunity to discuss the video with your supervisor or use the video to reflect on the interview by yourself. I did both, but I reflected more often than I talked with my supervisor. I learned a lot from reflecting."

Students also reported learning a lot by being attentive to learning opportunities and by turning their daily work into learning. Associated learning behaviours were *facing clinical problems, preparing* (for example, for a consultation) and *taking initiative* (doing and learning more than one was told to do). Students also described *trying out* and *applying* what they had previously learnt to new situations as well as *continuous practice* in situations considered suitable.

> Clerk 6: "Although it wasn't really my duty to come up with a treatment plan, I took the initiative and suggested my supervisor to start iron supplementation. I had looked that up in the resources before. It felt good to look that up and then apply it."

DISCUSSION

The aim of this study was to inventory the range of learning behaviours in the clinical workplace. In the interviews we asked students about their learning behaviours regarding knowledge acquisition, skills training and developing professional behaviour separately. We made this distinction to make sure that all relevant aspects of clerkship learning were covered, not to find major differences between these domains.

After interviewing the students we identified 31 behaviours which could be categorized in 5 themes. Some learning behaviours (eight in total) were reported for only one domain of learning, e.g. taking notes while being at work in order to go back to reference sources later was only reported for knowledge acquisition. This distinction makes sense in the light of social cognitive theory and participatory learning theories, which maintain that knowledge acquisition can be solitary, but training of skills and development of professional behaviour require real-life practice in a team.[21,22] On the other hand, most learning behaviours were reported for more than one domain of competence and for many teachers it will be easily conceivable that the learning behaviours reported for only one domain of competence could be applied to the other domains as well. For example, our students only reported talking about their experiences regarding professional behaviour, but their supervisors will see them talking about a lot more. A possible explanation is that we asked students to report activities that they thought had aided their learning. It might be that students perceived a lot of their talking as social talk, with little relation to their learning process. Our choice for interviews made it possible to inventory both overt learning behaviours like talking about experience as well as more covert learning behaviours like reflecting. Interviews also imply that the

researcher depends on the interpretation of the interviewee to gain the data. Further research involving teachers or using observation instead of interviews could confirm our expectation that although some learning behaviours are reported exclusively and probably preferred by students for only one domain of competence, these can be used in the other domains as well.

Given the current findings, it is probably best to consider both the social-cognitive perspective and the participatory perspective in the support of students. Our findings provide an overview of all learning behaviours students report using for these aspects of learning. This insight may help teachers recognize the learning behaviour patterns of their own students and advise them on possible strengths and pitfalls of these patterns. The overview also provides alternative learning behaviours, which may enrich the learning process in the clerkship phase of medical education.

The results of our study reflect two pronounced features of student learning behaviour: active learning behaviour and passive learning behaviour. We defined active learning as behaviour that students adopt on their own initiative. For passive learning behaviours students do not need to take initiative. Within this definition it is possible that some students will be diligent participants in learning

for which they did not take the initiative, for example learning from obligations (the third subtheme of passive learning behaviours). In an earlier study these obligations – especially observing – were considered important for an optimal learning process, because they are associated with a more encouraging learning environment,[23] which in turn has been shown to be conducive to students' achievement and success.[24] How active a student is in these obligatory learning experiences could therefore also impact that student's learning process.

In general, studying the profile of an individual student's active and passive learning behaviours may provide an indication of that student's position in the clinical learning process. This insight can be a tool for giving feedback to the students to help them make optimal use of the opportunities offered during the clerkships. When making such a profile of learning behaviours for a student, the learning environment should be taken into account. Some of the learning behaviours we found require more involvement of the student in the learning environment than others. From the interviews, it has also become clear that some departments may enhance active learning while other departments do the contrary. Therefore, in a discouraging learning environment, a student might

adopt different learning behaviours than this student would adopt in an encouraging learning environment. This is similar to adult students in higher education in general, some of whom change their way of learning in response to the learning goals they are trying to achieve or the expectations of the learning environment.[4] Future research is needed to explore to what extent such changes are part of students' clerkship learning profiles.

The goal of this study was to map *all* learning behaviours students report using in clerkships. We did not take account of the frequency with which the learning behaviours were used. We also did not investigate whether students differed in the learning behaviours they adopted or whether they preferred certain learning behaviours over others. It is possible that some students are more industrious regarding independent learning. Also, students might differ in their tendency to approach or avoid their learning environment.[21] These differences should be taken into consideration in future research. We are continuing our research by developing a questionnaire measuring learning behaviours in clinical practice, in which students' industriousness and tendency to approach or avoid the learning environment are included.

A limitation of this study could be that all participating students were volunteers from the same curriculum and study year. Besides, there were only thirteen students involved. Although such a number of participants is common in qualitative studies and we reached saturation, this restricted homogeneous sample might have limited direct extrapolation of our results. However, part of the learning behaviours we found correspond with several earlier findings on clinical workplace learning.[8,9,12, 25-27] For instance, *asking questions* was an important learning behaviour in a study describing the development of a Structured Learning Observation Tool.[25] Other learning behaviours – for example *observing* and *asking for feedback* – are in line with the clerkship experiences reported by medical students from another area of the Netherlands.[26] Finally, some of the learning behaviours reported by our students – for example *apply* and *practise* – were alluded to in a study on the process and outcomes of Real Patient Learning in the UK.[27] This national and international correspondence in results strengthens the generalizability of our findings.

To conclude: students reported a range of active and passive learning behaviours which also seemed to be influenced by their involvement in the learning environment. It is likely that each of

these learning behaviours can be used regardless of the competence domain (knowledge, skills or professional behaviour) the student is trying to develop. The current overview fits with existing educational theories on workplace learning and provides a solid base for the development of a new clerkship learning questionnaire. Such a questionnaire can be applied to achieve an individual learning behaviours profile that can be used in the support of students during their clerkships.

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CHAPTER 6:
Measuring students' learning behaviours during clerkships: development of an instrument

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ABSTRACT

Student clerkship learning behaviours can be categorized as interactive or independent. Insight into the extent to which clerks use these two types of learning behaviours is a prerequisite for supporting them in their learning. Therefore, we developed and validated a clerkship learning questionnaire and explored clerkship learning behaviours in practice.

Based on existing theory and research we developed a 19-item questionnaire consisting of two scales: interactive and independent learning. The questionnaire was administered to two groups of clerks (n=276 and n=187). We performed a confirmatory factor analysis to validate the questionnaire and checked reliability of both scales (Study 1). We compared clerks' combined scale scores to the group mean to arrive at an overall description of their learning in daily practice (Study 2).

The response rates were 92% and 76%. After removal of two items, the interactive and independent learning scales were confirmed; variance explained was 29%, reliability was 0.67 and 0.60 respectively. Relative to the group mean, 34% of students scored high on both interactive and independent learning; 21% scored low on interactive learning and high on independent

learning; 29% scored low on both interactive and independent learning and 15% scored high on interactive learning and low on independent learning.

We developed and validated a clerkship learning questionnaire that measures clinical workplace learning reliably at the group level. Given this level of reliability and the modest amount of variance explained, more research is required into the influence of the learning environment on student learning behaviours and how different ways of learning during clerkships affect student performance.

INTRODUCTION

Interaction with the learning environment is an important part of the clerkship learning process, because many aspects of clinical competence cannot be developed without participating in real-life tasks.[1-4] On the other hand, students also use independent learning behaviours that do not require interaction with the learning environment.[5] Insight into which learning behaviour(s) students use is a prerequisite for supporting them in their clerkship learning. Therefore, we developed and validated a clerkship learning questionnaire.

Both quality of the learning environment and student effort determine the learning process. Regarding the learning environment, according to students, three points are crucial to achieving optimal workplace learning: a) it should be clear what students are expected to do, b) a range of formal and informal learning opportunities should be offered, and c) students should be allowed to take part in departmental routines.[3,6] The quality of workplace learning varies due to different factors; such as supervision and feedback or the amount of exposure to relevant patients.[3,7] Students may adapt to such differences by adjusting their learning behaviours.[5,8-10]

In addition to the quality of the learning environment, the manner in which students interact with their learning environment plays a role in the learning process. Interactive learning behaviours involve the way students approach the learning environment, for example by asking for opportunities or asking for feedback.[5] Such learning behaviours are most easily used in a positive and supportive learning environment.[5] If a learning environment is experienced as more negative or even hostile, some students may be more likely to present avoiding behaviour, such as keeping quiet.

An instrument measuring clerkship learning behaviours should therefore also assess the students' tendencies to approach (or avoid) their learning environment.

Students also learn away from their clerkship workplace. This independent learning is mainly focused on knowledge acquisition and on the more cognitive aspects of workplace learning such as reflection.[5] According to social-cognitive theory, students differ in how industrious or negligent they are in independent learning.[11] For example, some students are more willing to spend time on studying at home than others. These differences are also likely to affect the students' learning process and should be covered in an instrument measuring clerkship learning behaviours.

One way to optimize students' learning processes is to provide them with feedback about which learning behaviour(s) they use and about possible alternatives.[12] The goal of our study was to develop and validate an instrument that measures the interactive and independent learning behaviours of students in the clinical workplace (Study 1) and to describe students' clerkship learning behaviours in practice (Study 2).

METHOD

Context

Both studies involved clerks from the University Medical Center in Groningen (UMCG), the Netherlands. Their curriculum consists of a three-year Bachelor's programme with patient-centred, competency-based education and a three-year Master's programme. The Master's programme mainly consists of clinical rotations and a six-month research project in the final Master's year. In the first Master's year students start their clerkships at the university hospital. In their second and third Master's years they go to one of six affiliated hospitals. All participants were in their second Master's year.

Under Dutch law, educational studies are exempt from ethical institutional board review. We discussed ethical considerations within the wider research group and with the teaching coordinators from the hospitals involved We also used published ethical standards to guide the research procedures.[13,14] Participation was voluntary, anonymous and on the basis of informed consent for both studies.

Development and validation of the instrument

Development

To represent both interactive and independent learning behaviours, we planned a questionnaire consisting of two scales: interactive and independent learning. The interactive scale was to contain learning behaviours reflecting the extent to which students actively approach their clinical learning environment in order to learn. The independent learning scale was to assess how industrious students are when learning independently. On the basis of previous literature and research, MvL wrote several items to represent each scale.[1-3,8] In addition, relevant items from existing questionnaires were included in this initial item pool.[10,15-17] Subsequently, item selection and revision took place through consensus discussions with a junior GP-trainee with a special interest in education, followed by a pilot study amongst a small group of clerks and consensus discussions between the authors. The criteria for a good item were:

- clear and unambiguous language
- relevance to clerkship learning
- focused on learning behaviour

Each item was described by a context followed by a learning behaviour to respond to (Table 1). The selection process eventually

resulted in a 19-item questionnaire. In an earlier study we found that in addition to the differentiation between interactive and independent learning behaviours, a distinction could be drawn according to the level of student activity in learning.[5] To represent this distinction, all items were to be answered on a frequency Likert scale (1=never to 7=always).

Table 1 Items and reliability per factor

Interactive learning (Cronbach's alpha = 0.67)
If I don't understand something during my work,
1. *I wait for someone to explain it to me.**
To find out what my strengths and weaknesses are,
2. I ask for feedback.
When things are not going well between me and my supervisors,
3. I try to talk with them about it.
To discover what I need to improve on,
4. *I wait for feedback from a colleague or supervisor.*
If I want to practice a skill,
5. *I wait for the scheduled moments.*
If I get to a department where the clerk is not allowed to do much,
6. *I adjust to that.*
If I want to improve my skills,
7. *I wait for my supervisor to invite me to watch him/her.*
If the circumstances at the department hamper my learning,
8. I try to do something about it.
(continued on next page)

Table 1 Items and reliability per factor *(continued)*

Independent learning (Cronbach's alpha = 0.60)

Before starting a consultation,
9. I prepare for the patient's problem.

If I want to improve my skill,
10. I look for someone who is good at it, to see how he/she proceeds.

If I don't know something during work and I cannot look it up immediately,
11. I write it down for later reference.

To do everything that I want to do,
12. I plan when and how I will arrange my learning.

If I want to develop my own way of working,
13. I observe the effect of diverging approaches that others use.

If I want to know more about a topic,
14. I look it up.

To improve my overall performance,
15. I myself think about my strengths and weaknesses.

If I need extensive information on something,
16. I consult UpToDate.

If the consultation went difficult,
17. I try to think about the cause afterwards.

* Scores on items printed in *italic* are reversed, so that a high score always indicates activeness on the part of the student.

Validation

A first group of clerks (n=276) was asked to complete the questionnaire during a scheduled class meeting. In addition to this internal validation study, we asked further questions on the clarity and relevance of the items and on the coverage and representativeness of the items with respect to the students' own

learning to get more information about the external validity. We also provided space for further comments.

Descriptive statistics were calculated for each item separately to check for restriction of range and extreme scoring. We used this information and the clerks' comments about clarity and relevance of the items to determine whether items had to be excluded from the analyses described below. If participants had skipped fewer than 10% of the items, missing data were replaced with their mean score on the remaining items; if participants had skipped more than 10% of the items, their data were removed from the analyses.

To confirm the interactive and independent learning scales, we used the Oblique Multiple Group Method (OMGM).[18,19] This analysis permits confirmation that every item actually correlates best with the factor it was assigned to on theoretical grounds. To exclude the effect of each item automatically correlating with the factor it is part of, the OMGM presents a corrected correlation. The percentage variance explained is an indicator of the match between the pre-determined factors and the data.
In an OMGM-analysis the resulting factors may be correlated. To verify whether this was the case, we first inverted the scores on

items that had a negative loading on the interactive learning or the independent learning scales. Next, we calculated two scale scores for every participant by taking the mean of the items belonging to each scale. Finally, we calculated the correlation between these scale scores.

The maximum score on both scales was 7, the minimum score was 1. A score of 7 represents a strong approaching or a strong industrious tendency, while a score of 1 represents a strong avoiding or a strong negligent tendency.
Cronbach's alpha was determined for both scales. For basic correlational purposes where the focus is on groups and newly developed instruments, Cronbach's alpha should be at least 0.60.[18]

Students' clerkship learning behaviours in practice

In autumn 2010, we asked a second group of clerks (n=187) to complete the questionnaire, following the same procedure as in our first study. To confirm that our questionnaire was also appropriate for this second group of participants, data-analysis again commenced with calculating descriptive statistics to check for restriction of range and extreme scoring. We checked Cronbach's

alpha for each scale to corroborate the internal consistency of the questionnaire.

Our main goal in Study 2 was to describe how clerks learn in daily practice. The questionnaire yields scores for interactive and for independent learning. These scores can be combined in a two-dimensional plot to attain an overall description of a student's learning, depending on whether the student scored high or low on the interactive and independent learning scales. In agreement with the common practice in social sciences that participants' behaviour be assessed relative to the group, we used the mean score per dimension as the norm to determine whether the student scale score on interactive and independent learning is high or low.

RESULTS

Development and validation of the instrument

In Study 1, of the 276 questionnaires distributed, 253 were returned (92%). Data from two clerks were excluded, since these clerks had skipped more than 10% of the items. There was no indication that any of the items needed to be excluded or that important aspects of clerkship learning had been missed.

The OMGM revealed that only one of the intended independent learning items did not correlate best with the scale it was supposed to be a part of. Further inspection of the content of the items led to the conclusion that this item and one other might not be pure indicators of independent learning behaviours as described in our theoretical framework. These items were removed iteratively and the OMGM was rerun. After removal of both items, the remaining items correlated best with the scales they were supposed to be part of. The amount of variance explained by this final solution was 29%. The final 17-item questionnaire (Table 1) contained 8 items for interactive learning and 9 items for independent learning. The Cronbach's alphas were higher than the criterion for basic correlational purposes where the focus is on groups: 0.67 and 0.60 for interactive learning and independent learning respectively. Mean scores were higher than the midpoint of the scale: 4.6 and 5.3 for interactive and independent learning respectively. The correlation between the tendency towards approaching behaviour in interactive learning and the tendency to be industrious regarding independent learning was 0.13 ($p<0.05$).

Students' clerkship learning behaviours in practice

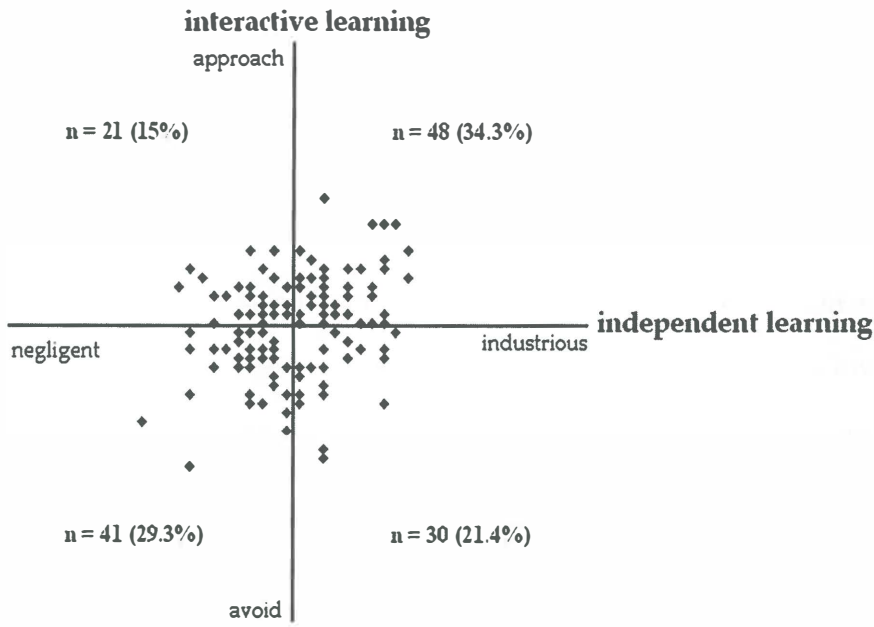
In Study 2, of the 187 questionnaires distributed, 143 were returned (76%). The results from three clerks were excluded, since they had skipped more than 10% of the items. The questionnaire was appropriate for this group of participants as well: in the OMGM all items correlated highest with the scale they were supposed to be part of. The amount of variance explained was again 29%. Cronbach's alphas were 0.68 and 0.61 for interactive learning and independent learning respectively.

In Study 2, the students' scores on interactive learning ranged from 2.6 to 6.4, with a mean of 4.6 and standard deviation of 0.68. For independent learning the scores ranged from 4.0 to 6.4, with a mean of 5.4 and standard deviation of 0.52.

A third of the clerks scored high for both interactive and independent learning: they actively approached their learning environment and were industrious (Figure 1). Another third scored low on both scales: these clerks seemed to avoid their learning environment and were more negligent. A fifth of the clerks scored high on interactive learning and low on independent learning: these clerks actively approached their learning environment, but were more negligent regarding independent learning. The remaining

clerks scored low on interactive learning and high on independent learning: these clerks seemed to avoid their learning environment, but they were industrious regarding independent learning.

Figure 1 Clerks' scores on the interactive and independent learning scales in relation to the group-mean
(4.6 and 5.4 for interactive and independent learning respectively)



DISCUSSION

We developed and validated a questionnaire to measure students' clerkship learning behaviours, taking into account interactive and independent learning in clerkships. The intended two scales

(interactive learning and independent learning) were confirmed. Relative to the group mean, 34% of the students scored high on both interactive and independent learning; 21% scored low on interactive learning and high on independent learning; 29% scored low on both interactive and independent learning; and 15% scored high on interactive learning and low on independent learning.

The two scales on interactive and independent learning reflect current literature on learning.[11,20,21] In recent years, social cognitive theory has usually been used to describe medical education and learning. According to social cognitive theory, the students need to be in control of their learning, decide which sources they will use and be active in their learning activities.[11] The learning environment can be an important resource, but other resources are also available and therefore, students may decide to learn on their own. Recently, participatory perspectives of learning have received increasing interest in medical education literature.[20] According to these perspectives, students learn best by performing relevant and authentic tasks (learning by doing) and by interacting with the team in their daily tasks. In particular this aspect of participatory learning is represented by our first scale: interactive learning. It has been argued that both the socio-cognitive and the participatory perspectives are incomplete on their own and that future research

could benefit from considering these perspectives together.[21] This is because any two students will have different learning needs and any two supervisors will have different ways of supporting the students.[8,21] Only focusing on either interactive or independent learning implies the risk of considering the other way of learning as abnormal or wrong. Considering both aspects of learning simultaneously allows people to choose the way of learning and teaching that suits them best.[21] Our questionnaire helps to reveal the extent to which individual students use learning behaviours related to both interactive and independent learning. This information could enhance supervisors' support by tailoring to the student or by advising the student on alternatives.

To validate our questionnaire, we looked at construct validity (OMGM and the theoretical framework), internal consistency (OMGM and Cronbach's alpha) and external validity (replication study). These were all adequate. To further our understanding of the concepts that the questionnaire measures, future research could also consider other aspects of validity, such as reproducibility and responsiveness to interventions.

We would expect the questionnaire to be reproducible only in the short run, however, given the strong influence the learning environment can have on the students' learning processes.

In an earlier study students reported using multiple learning behaviours in a single clerkship.[5] In the current study we observed the same: every student reported several learning behaviours that he/she used regularly. Given these findings, it appears to makes more sense to look at a learning behaviour profile than at individual learning behaviours. When building a 'learning behaviour profile' of an individual student, the influence of the learning environment on the student's learning behaviours should be considered. Students sometimes change their learning behaviour(s) in response to the learning environment, particularly if that learning environment is suboptimal.[5] This is true for both interactive and independent learning, but especially in interactive learning the impact of a negative learning environment can be great.[1-5]
The influence of the learning environment can be taken into account by building the learning behaviour profile based on the student's interactive and independent learning scores in comparison to a reference group. This is common practice in social sciences when examining concepts that depend on many factors, so we built the

students' profiles in our second study accordingly. When a learning behaviour profile is built in this way, the choice of reference group is crucial.

In Study 2, we used the group mean as the reference for deciding what a high or low score is. Given that the mean scores in Studies 1 and 2 were quite similar (4.6 and 4.6 for interactive learning, 5.3 and 5.4 for independent learning; for Study 1 and 2 respectively), it seems likely that this was an appropriate reference point for our participants. Nevertheless, the total number of participants in Studies 1 and 2 is still too small to consider this reference point generalizable outside the population of Groningen students. In social sciences in general, it is common to include thousands of participants in studies on reference groups. Therefore, more research is required to establish a more widely generalizable reference group for high and low scoring on interactive and independent learning.

Another question would be whether certain learning behaviour profiles are more effective than others. We are unable to answer that question yet, because no performance measure was included in our studies. Based on our findings and current literature, we can

formulate several expectations, which should be subjected to further research.

First, students who score at the extreme high end of both interactive and independent learning are active both in their independent development and in the interaction with their supervisors. They can be expected to get the best of both worlds: access to the expertise of their superiors when it is available and an adequate amount of learning experiences when it is not. This may increase their flexibility in learning, because they can adjust their learning behaviours to the availability of their supervisors, which in turn is presumed to lead to better learning outcomes.[8,22] Therefore, we would expect students with this learning behaviour profile to perform best during clerkships.

Our second expectation concerns students who score at the low end of both interactive and independent learning. These students may come across as passive. A similar kind of passivity has been identified in cognitive workplace learning with the Approaches to Learning at Work Questionnaire, as a surface-disorganised learning strategy.[16] Surface-disorganised learning has been associated with lower test scores in general workplace settings and lower wellbeing in medical settings.[16,23,24]

Therefore, we would expect students with this kind of learning behaviour profile to do worst in their clerkships.
As argued above, these are tentative hypotheses based on our findings in relation to other literature. Since the focus in our studies was on developing an instrument and measuring students learning in daily practice, we did not include performance. Therefore, more research is needed to analyze the effectiveness of different learning behaviour profiles during clerkships.

A strength of our study is the careful construction and analysis of the questionnaire, involving the viewpoints of educationalists and doctors involved in clerkship training as well as the viewpoints of clerks from a variety of hospitals and disciplines. Another strength is the high response rate, which provides confidence that the results from the factor analysis are replicable in other contexts.
A limitation is the relatively low amount of variance that the factor solution explained. This could indicate that clerks learning behaviours are influenced by more than their tendency to be industrious and to actively approach a particular learning environment. Such influences can be curricular obligations, the clerk's mood or the availability of certain resources (if there are no computers, you cannot look something up in an online professional

database).[5] These influences should be studied to get a more complete view of why and how students adopt certain ways of learning. However, the focus in the current study was on *which* ways of learning students adopt, something that our questionnaire can measure better than previous ones.

We developed and validated a clerkship learning questionnaire that fits with current knowledge on clinical workplace learning. To build a profile per student from this questionnaire, more research is required into the influence of the learning environment on students' learning behaviours and on the most adequate reference group. This information could enhance supervisors support by informing them how to tailor their guidance to the students' needs or advise them on alternatives. Students' scores on independent and interactive learning can also be of use in future research on the effectiveness of different ways of learning during clerkships.

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CHAPTER 7:
Discussion

The clinical clerkship is a unique experience in a physician's career. The learning process in this period is crucial for the student's future as a doctor[1,2] and it is therefore essential to offer optimal learning conditions for the medical student in this final phase of the basic curriculum. This thesis deals with medical students' development of clinical performance and their wellbeing in relation to the use of learning strategies and learning behaviour in general. In the current chapter, we reconsider the results of our studies taken together and in relation to the literature. We also discuss the practical value and strengths and limitations of our studies as well as future perspectives.

Main findings

Students' clinical performance should improve continuously during the clerkship period. This performance can be assessed in separate exams and the reliability of the final judgment grows with increasing numbers of assessments. When taking the progress in performance into account, we found that the number of assessments needed to achieve a reliability of 0.80 decreased from 17 to 11 (chapter 2).

Subsequently we investigated the relation between students' learning strategies and the marks they obtained during the

clerkships (chapter 3). There was a small trend for surface-rational learning to be associated with increased marks and a small trend for surface-disorganised learning to be associated with decreased marks, but overall we had to conclude that there was no clear relation between learning strategy and clinical performance as expressed in the marks given by clinical supervisors.

Another type of learning outcome is students' wellbeing as measured through their amount of distress. We studied the relation between this outcome and reflection and self-regulation (chapter 4) and found distress, reflection and self-regulation to be recursively related to each other.

Subsequently we tried to obtain an overview of students' clerkship learning behaviours by interviewing clerks about their clerkship learning behaviours (chapter 5). Many learning behaviours (e.g. asking for feedback) were used across all three domains of competence – knowledge, skills and professional behaviour– but some were more specifically confined to one particular domain. Five main themes emerged from students' recounts of their learning: disengaging learning behaviour, waiting to be involved in clinical practice, learning from obligations, independent accumulation of knowledge and taking initiative in clinical practice.

Many of the reported learning behaviours could also be categorised based on whether or not interaction with the learning environment was required to perform them.

We used our results in combination with findings from earlier studies on clerkship learning[3-5] and current workplace learning theories in the development and validation of a new questionnaire (chapter 6). This questionnaire contains two scales (*interactive learning* and *independent learning*) which both had acceptable internal consistency (0.68 and 0.60 respectively). Although the clerks were quite active overall, there was enough variation between clerks to distinguish four learning behaviour profiles according to students' tendency to approach their learning environment in interactive learning in combination with their tendency to be industrious regarding independent learning.

Wellbeing

As an intermediate learning outcome

One type of learning outcome we looked at in this thesis is *wellbeing*. We studied wellbeing in the project described in chapter 4 – a combined project for Scandinavia and the Netherlands – where we took distress as a measure of (lack of) wellbeing. The recursive pattern we found, in particular between self-regulation and distress,

brings into question whether distress should be viewed as a final outcome only or also as an intermediate outcome within a cyclic relation.

We founded the importance of reducing distress in two ways. Distress should be reduced because of the personal costs and suffering that arise for the individual experiencing considerable distress.[1,6] Distress should also be reduced because high levels of distress negatively affect learning and performance.[7-9] In this second argument, distress is also considered as an intermediate outcome, like it was in our findings regarding reflection and self-regulation. If distress is indeed an intermediate outcome, is wellbeing in general then an intermediate outcome as well? Recent literature seems to suggest it is. In an earlier model on clinical workplace learning, students' 'state of mind' also held an intermediate position.[3] Students' state of mind, for example their confidence, was supposed to be affected by how much they could participate. A positive state of mind, in turn, led to higher performance. Students' performance then impacted on the amount of participation. Therefore, the proposed relations between participation, state of mind and performance were also recursive, like the relations we found in our study on distress.[3] Since a positive state of mind is an important aspect of someone's wellbeing, this is a further indication

that wellbeing in general should be viewed as an intermediate learning outcome.

In both the earlier model as mentioned above and our own findings on distress, the intermediate nature of wellbeing became apparent, because it was part of a recursive model. Such recursive models imply the possibility of vicious cycles and positive spirals. For example, with respect to distress, students can get into a vicious cycle where increased distress leads to lowered self-regulation in turn leading to even higher stress, and so on.

It remains to be determined, however, whether and how often such vicious cycles or positive spirals regarding wellbeing really occur. In chapter 4 we also discussed the possibility of changing a vicious cycle into a positive spiral, by alleviating distress or by enhancing self-regulation through training. The feasibility of such distress-reducing training remains to be established.

In relation to students' learning behaviours: the need to be active

In our distress study, only two learning behaviours were included: reflection and self-regulation and the relation with reflection was small. The question remains how wellbeing is related to clerkship learning behaviour in general.

For self-regulation and, to a lesser extent, reflection, we found that a higher score leads to lower distress. In other words, clerks need to actively engage themselves with these learning behaviours. This need to be active was also described in the interview study in relation to learning in general. Clerks described having a better clerkship when they actively engaged their learning environment and asked for anything they needed. This is reflected in our questionnaire by a high score on the scale interactive learning. We would hypothesize that students who score high on the other scale, independent learning, will have less stress as well, because they are able to create learning opportunities for themselves in any learning environment. Therefore, we expect clerks who score higher on both scales to have a better wellbeing than students who are less active regarding interactive and/or independent learning, but this expectation still needs to be confirmed.

Performance

We also investigated the relation between students' learning behaviours and the learning outcome *performance*. Performance could be measured reliably (chapter 2), but we did not find a clear relation with students' learning strategies (chapter 3). We already discussed that this was most likely due to the questionnaire we

used, which did not cover participatory learning behaviours that are important for clerkship learning, in particular for skills and professional behaviour. We have now developed a new questionnaire (chapter 6) which could lead to other results.

Recently it has been postulated that medical students' way of learning will not bear any relation to their performance, "because all medical students are generally highly motivated and very capable".[10] According to our observations this is too brave an assertion. As described in chapter 4 we feel that students respond differently to a similar learning environment. Sometimes students confronted their supervisors when the learning environment was suboptimal, but sometimes they also kept quiet and avoided their supervisors. So in spite of high motivation and capability medical students may still adopt diverging ways of learning, especially regarding interactive learning. These differences in learning may in turn affect the efficacy of the learning process.

Differences in interactive learning have not been covered before. Most of the research on which the conclusion about "motivated and capable students" is based, has been done with the concepts of deep and surface learning and other independent cognitive views on learning. One may wonder whether such distinctions are relevant in

clerkships where independent cognitive information processing and participatory learning are both important . Whether and how differences in this broader range of learning behaviours relate to performance remains unanswered, but could be examined with our questionnaire, which incorporates both differences in independent cognitive learning and differences in interactive learning.

Use of the questionnaire

Using a questionnaire to explore learning behaviour in groups of students or single persons can be useful for research and diagnostic reasons in the individual case. The latter is most important for those students who apparently have a hard time during clerkships to find out whether learning behaviour has anything to do with their lower performance or wellbeing[11].

Previously developed questionnaires to measure students' learning behaviour profiles can all be retraced to two different theoretical frameworks.[10,12] The *learning style framework* supposes that, at least for adult students like medical clerks, the way of learning is relatively fixed, like a personality trait.[13,14] The *learning strategies framework* on the other hand poses that while personality indeed influences the way people learn, it also depends to a large degree on their learning goals and circumstances.[12,14-16] This means people can

change their way of learning depending on what they are trying to achieve in which context.

In our interview study we found that clerks' learning behaviour actually was flexible with respect to their learning goals. Clerks' main learning behaviours for knowledge were different from their main learning behaviours for skills and professional behaviour. Furthermore, clerks could change their learning behaviour in response to their learning environment. Sometimes clerks would decide to actively engage a suboptimal learning environment and sometimes they would remain in the background. Since the results of these interviews were a base for our questionnaire, the questionnaire is probably best placed in the learning strategies framework.

Usually, the scales of a questionnaire (in our case interactive learning and independent learning) are equated with distinct learning strategies.[12,15,16] However, we found our scales to be correlated. Furthermore, we observed that the scales contained learning behaviours that can be used complementary. Therefore, clerks' learning strategies are probably best described with a complex variable that results from a combination of these two scales. In chapter 6 we combined the two scales into four different

learning strategies: 1) approaching interactive learning and neglect of independent learning, 2) approaching interactive learning and industrious with independent learning, 3) avoiding interactive learning and neglect of independent learning or 4) avoiding interactive learning and industrious with independent learning. As argued in chapter 6, we expect future research to show that students with an approaching and industrious learning strategy will do best and students with an avoiding and negligent way of learning will do worst.

Strengths and limitations

Paradigmatic issue

In this thesis we focused on the learning behaviours and learning strategies through which clerks try to develop themselves in the workplace. This type of research originates from theoretical perspectives like cognitive psychology and social-cognitive theory. Such theories are focused on how a student develops and, in the context of workplace learning, acquires a professional identity.[17] Cognitive psychology focuses on individual processes like organising and storing knowledge, memory and making meaning of experiences.[18] Despite this individual focus, studies based on social-cognitive theory and workplace-based learning theories do

include the learning environment as a factor in their work.[19] The learning environment is considered important because it provides the resources and expertise the student needs to learn. Nevertheless, in this theoretical perspective, regardless of what the learning environment offers, it is the student who decides whether or not to engage with these opportunities.[19]

A strength of using this theoretical perspectives is that these are congruent with common values in medicine, such as autonomy and self-reliance, which portray an individualistic view on how the doctor should be as a professional.[18] A limitation is that these theoretical perspectives focus on competence as an individual attribute (learning as acquisition) and do not incorporate the competence that can ensue when people come together in a team, as is usually the case at the clinical workplace (learning as participation). According to Sfard, to represent the full complexity of medical training, both the individual acquisition perspective and the socio-cultural participation perspective are needed.[17] Therefore, the participatory view on competence and learning has recently received increasing attention in medical education.[18,20,21] Lave and Wengers' communities of practice and the workplace learning theories of Billet and Eraut are examples of theories within

this perspective.[18,22-24] This type of theory is much more focused on the collective development of competence as a team.

One important aspect shared by these theories is that individuals learn by becoming part of this competent team and by participating in daily routines and activities; moving from peripheral to more central team business. The initiative for this move from periphery to centre may come from the established team, but can also be taken by clerks.[24] Clerks often spend a relatively short period (several weeks to a couple of months) in a department, making it harder for staff members to judge what the most appropriate tasks are for them. In the situation that clerks feel they can contribute more than they are allowed, they could take the initiative themselves. This aspect of participatory learning was visible in the interview study (chapter 5), where one clerk described making a suggestion beyond his duties, which was then followed up on.

Since we focused on differences in students' learning behaviour, another key aspect of participatory learning theories was not explored: the reciprocal nature of learning at the workplace. Participatory learning theories hold that members do not only learn from the team, they also contribute to the learning of the team.[17,18] In the collaborative learning process that thus ensues, each members' learning strategy can influence that of the others. This raises

questions such as how individual learning behaviours impact on the learning process of the entire team. These questions are beyond the scope of this thesis.

Methodological issues

In the study on the reliability of clinical performance (chapter 2), we combined generalizability theory and multilevel theory.[25-27] This combined approach enables one to take the development of students over the course of a longitudinal assessment into account in reliability analyses. Because clerks' development over the course of their clerkship assessment turned out to have a significant impact on the reliability estimates, this combined approach constitutes a strength of this thesis.

In the study on the relations between distress, reflecting and self-regulating (chapter 4), we used Structural Equation Modelling (SEM).[28] In this study, we wanted to test conceptual models on the relations between distress, reflection and self-regulation. with SEM one estimates both the measurement error and the concepts under study separately and then calculates the relations between the underlying concepts irrespective of the measurement error. A strength of this study is that we were able to enroll the many participants needed to do a SEM study and a replication. The SEM

technique provided a way to inspect the conceptual relationships between constructs, even though the data were gathered through a non-experimental design.[28]

A limitation of this thesis is that all data rely on clerks' self-report. Self-reports are not always accurate. Participants' memory and reporting are influenced by psychological processes such as self-enhancement and social desirability.[29-31] One may question whether clerks will correctly remember how they learned and, if they do, whether they will accurately report on this. However, data from other perspectives (for example, supervisors or observation) would be influenced by the same psychological processes.[31,32] Moreover, self-report data sometimes are the only way to access the information needed.[32] This thesis was focused on learning behaviour and many learning behaviours cannot be seen. Such covert learning behaviours (for example thinking or planning) cannot come up in data from supervisors or observers. Therefore, we could have missed a broad range of learning behaviours if we had relied on data from others than students. In addition, observation would not have been feasible, since it would have meant spending more time per participant and fewer participants could have been included. A second limitation of this thesis could be the restricted number of participants we could include in the

interview study. Saturation was reached, but thirteen participants is still a limited number, especially considering the importance of this study was to explaining the outcomes of the study in chapter 3 as well as to the development of our questionnaire in chapter 6.
In part we tried to overcome these limitations of self-report by using the technique of stimulated recall in the interview study and by guaranteeing the anonymity of the participants in our other studies.[29] In particular, in the questionnaire study, none of the participants reported that we had missed important aspects of their learning behaviour. These participants also confirmed the relevance of the items developed from the interview study, indicating that although only thirteen students had participated in the interviews, their experiences were representative for other clerks. Furthermore, we did triangulate the clerks' reports informally by discussing our research with the clerkship coordinators and with doctors with a special interest in education. Since our findings also complement other studies and literature in this field, based on other types of participants and different techniques, we feel that limiting ourselves to the students' perspective did not greatly bias our outcomes.

Concluding remarks

The goal of this thesis was to further clarify whether and how differences in medical students' learning behaviours affect their clerkship learning outcomes. In the course of our studies we developed an instrument to measure these learning behaviours. Although we have made plausible that the activity of clerks regarding their learning behaviours influences their learning outcomes, in particular wellbeing, more research is needed to confirm that expectation. For such studies our new questionnaire will be useful. The questionnaire can also be used for individual counselling to support clerks in making the most out of their workplace learning experiences.

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SUMMARY

Students' clinical clerkship rotations are an essential part of undergraduate medical training. In *Chapter 1* we introduce the clinical workplace as a learning environment where students need to integrate and further develop their knowledge, skills and professional behaviour to become autonomous and competent doctors. The clinical workplace is a complex environment for learning, because many different people are involved in the medical process – and therefore the learning experiences – each with their own view of the situation. The view of the patient – who is the focus of the medical process – in particular can be quite different from the views of healthcare professionals.

There often is little room for correction of error, given the consequences that can ensue. Finally, emotions play a major role in the medical process. These differ for patients, health care professionals and the inexperienced student: conflicts between these various emotions can easily arise, making the clinical workplace a very complex learning environment.

The most important influences on clinical workplace learning are often described in the literature on the basis of the following facets: 1) the learning environment, 2) student characteristics and behaviour, and 3) the interaction between the two. In this thesis the

main question is: which student factors play a role in clinical workplace learning?

Two types of learning outcomes are studied: performance and wellbeing. A plausible measure for clinical performance is the final grade awarded in the clinical assessment programme. To use the final grade as an outcome measure, it must be a reliable indicator of the student's performance. Clinical performance is assessed in several exams over the course of a clerkship – these judgements together lead to a final grade. The reliability of such a final grade increases when the number of judgements increases. We have therefore investigated using a multilevel generalizability study, how many judgements are required to have final grades with a reliability of 0.80 (*Chapter 2*). Since the judgements are dispersed across an entire clerkship, students are likely to develop between judgements, which may lead to higher marks in later judgements, increasing the variability in a single student's marks. Variation in marks between single student's judgements is usually considered undesirable and therefore unreliable. The increased undesirable variability can influence the reliability of the final grade. However, when this variation is due to the student's development, it can be considered desirable. We decided to include students' development

into our reliability analysis, since we expected the reliability of the final grade to increase if student development would be taken into account. In all, we analysed 574 judgements of 104 clerks. When taking development in performance into account, the number of judgements needed to achieve a reliability of 0.80 for the final grade decreased from 17 to 11.

A student factor that seems to influence performance in the preclinical phase is the students' learning strategies. In our second study we investigated to what extent the students' learning strategies and clinical performance were related in the clinical phase (n=113, *Chapter 3*). There was no clear relation between learning strategy and clinical performance, although there was a small, positive trend for surface-rational learning (focused on the reproduction of facts and guidelines) and a small, negative trend for surface-disorganised learning (dependent on supervisor regulation, fragmented). A possible explanation lies in the questionnaire we used, the Approaches to Learning at Work Questionnaire. This questionnaire is validated for workplace learning in general, but is mainly focused on knowledge acquisition. Adequate learning and performance in clerkships requires more than knowledge alone; students have to develop skills and professional behaviour to

become competent doctors. A study of possible differences in the learning behaviours used for these three competence domains is presented in *Chapter 5*.

In *Chapter 4* the focus is on a second type of learning outcome: wellbeing. In this study wellbeing is operationalized as distress or lack thereof. Earlier studies have shown that high levels of distress are negatively associated with performance and learning at the clinical workplace. Using Structural Equation Modelling, different models have been analysed on the conceptual relations between distress on the one hand and the student characteristics reflection and self-regulation on the other, in a combined project for Scandinavia (1010 students) and the Netherlands (129 students). The relations we found were similar for the Scandinavian and the Dutch samples. Of the models that seemed plausible on the basis of literature, a recursive model – one in which all variables are both cause and consequence of each other – fit best. In this model, distress, reflection and self-regulation continuously interacted with each other. The relation between distress and self-regulation was clearly stronger than the other two (β-coefficient -0.48 compared to -0.02 and 0.10). From earlier research it is known that self-regulation

can be taught. Our results imply that students with high levels of distress could benefit from such training.

From the findings in *Chapter 3* we surmised that the learning behaviour for clerkships was different for skills and professional behaviour than for knowledge. The goal of the study described in *Chapter* 5 was therefore to obtain a full overview of the learning behaviours students use in clerkships to further develop their knowledge, skills and professional behaviour. Only part of the learning behaviours – described in the 13 interviews – turned out to be unique to knowledge, skills or professional behaviour. Most learning behaviours were reported for two or three of these competence domains. A more fitting distinction for all the reported learning behaviours seemed to be that between active and passive learning behaviours. Active learning encompassed the subthemes independent accumulation of knowledge and taking initiative in clinical practice. Passive learning encompassed the subthemes disengaging learning behaviour, waiting to be involved in clinical practice and learning from obligations. A second distinction could be drawn for all reported learning behaviours, based on whether or not participation with the learning environment was required to perform them.

These results, in combination with findings from earlier studies on clerkship learning and current workplace learning theories, formed the basis for the development and validation of a new clerkship learning questionnaire (*Chapter 6*). This questionnaire is designed to measure students' activeness on two scales: interactive learning and independent learning. These scales were corroborated through confirmatory factor analysis (n=253, Cronbach's alpha reliabilities 0.68 and 0.60 respectively). We used this final questionnaire in a second study involving 143 clerks. Four learning strategies could be discerned based on the clerks' tendency 1) to approach their learning environment through interactive learning and 2) to be industrious regarding independent learning. These four learning strategies were: approaching interactive learning and neglecting independent learning (15%), approaching interactive learning and being industrious with independent learning (34%), avoiding interactive learning and neglecting independent learning (29%) or avoiding interactive learning and being industrious with independent learning (21%).

In the final *Chapter* (*7*) we reconsider the results of the studies taken together and in relation to other literature. We conclude that active clerkship learning should be stimulated because more

reflection and more self-regulation – both aspects of active learning – are related to lower distress, and because clerks in the interview study reported that being active led to more (and more varied) learning experiences at the workplace. Earlier research has shown that workplace performance is related to both the amount of distress experienced and the amount and diversity of the learning experiences. In our questionnaire, active learning is reflected in a high score on both interactive and on independent learning. The new questionnaire therefore appears to be useful for future studies of clerkship learning.

SAMENVATTING

Het leren op de klinische werkplek tijdens coassistentschappen, is een essentieel onderdeel van de basisopleiding Geneeskunde. In *Hoofdstuk 1* is de klinische werkplek omschreven als een leeromgeving, waarbinnen coassistenten hun kennis, vaardigheden en professioneel gedrag moeten integreren en verder ontwikkelen, om uiteindelijk autonome en competente artsen te worden. De klinische werkplek is een complexe omgeving om in te leren, omdat er een groot aantal verschillende personen bij het geneeskundig proces – en dus bij de leermomenten – betrokken zijn, die ieder hun eigen kijk op de situatie hebben. Met name de visie van de patiënt – die centraal staat in dit proces – verschilt vaak nogal van de visie van hulpverleners. Gegeven de levensbelangen die op het spel kunnen staan, is er vaak weinig ruimte voor het ongedaan maken van onjuiste acties. Tenslotte spelen emoties een grote rol in het geheel. Deze zijn verschillend voor de patiënt, de hulpverleners en ook nog weer voor de student die nog weinig ervaren is; een conflict tussen deze verschillende emoties ontstaat snel, wat de leeromgeving zeer complex maakt. In de literatuur worden de meest belangrijke invloeden op het werkplekleren vaak beschreven aan de hand van de volgende facetten:
1) leeromgeving, 2) studentkenmerken en -gedrag en 3) interactie tussen deze twee. De hoofdvraag van dit proefschrift is: welke

studentfactoren spelen een rol bij het leren op de klinische werkplek?

We hebben naar twee uitkomsten van het leren op de klinische werkplek gekeken: prestaties en welbevinden. Een mogelijke maat voor klinische prestaties is het eindcijfer van het coassistentschap. Om een dergelijk eindcijfer als uitkomstmaat te kunnen gebruiken, moet het een betrouwbare weergave zijn van de prestaties van de student. In het betreffende programma zijn de klinische prestaties van studenten meerdere keren beoordeeld tijdens één coassistentschap; deze beoordelingen leiden samen tot één eindcijfer. Uit de literatuur is bekend, dat de betrouwbaarheid van een dergelijk eindcijfer toeneemt, naarmate het aantal onderliggende beoordelingen groter is. Daarom hebben we – middels een multilevel generaliseerbaarheidstudie – onderzocht hoeveel beoordelingen er nodig zijn om een betrouwbaarheid van 0.80 voor de eindcijfers te bereiken (*Hoofdstuk 2*). Aangezien beoordelingen verspreid over het hele coassistentschap worden gegeven, is het aannemelijk dat studenten zich – tussen de beoordelingen in – verder ontwikkelen. Dit kan leiden tot hogere beoordelingen later in het coassistentschap, waardoor de variatie in beoordelingen per student toeneemt. Doorgaans wordt variatie in

beoordelingen als ongewenst en dus onbetrouwbaar beschouwd. Echter, variatie in beoordelingen die ontstaat doordat de student zich verder ontwikkelt, valt als wenselijk te beschouwen. Indien de mate van ontwikkeling bij de betrouwbaarheidsanalyse wordt betrokken, valt te verwachten dat de betrouwbaarheid van het eindcijfer hoger wordt. De mate van ontwikkeling van de student werd daarom meegenomen in onze betrouwbaarheidsanalyses. In totaal werden 574 beoordelingen van 104 coassistenten geanalyseerd. Indien rekening gehouden werd met de doorgemaakte ontwikkeling, daalde het aantal beoordelingen dat nodig is om de nagestreefde betrouwbaarheid voor het eindcijfer te behalen van 17 naar 11.

Een van de studentfactoren die de prestaties in de preklinische fase lijkt te beïnvloeden, is de leerstrategie van de student. In onze tweede studie zijn we nagegaan in hoeverre de leerstrategieën van studenten in de klinische fase samenhangen met hun prestaties (n= 113, *Hoofdstuk 3*). Wij vonden geen eenduidig verband tussen leerstrategie en klinische prestaties, hoewel er wel een kleine (positieve) trend zichtbaar was voor oppervlakkig-rationeel leren (gericht op reproductie van feiten en richtlijnen) evenals een kleine (negatieve) trend voor oppervlakkig-ongeorganiseerd leren (gericht

op sturing door de begeleider, gefragmenteerd). Een verklaring voor deze onverwachte uitkomst ligt in de gebruikte vragenlijst, de Approaches to Learning at Work Questionnaire. Deze vragenlijst is gevalideerd voor werkplekleren in het algemeen, maar primair gericht op het verwerven van kennis. Naast het verwerven van kennis, zijn voor coassistenten echter ook het aanleren van vaardigheden en het ontwikkelen van professioneel gedrag belangrijke aspecten van werkplekleren. Een nader onderzoek naar mogelijke verschillen in leergedrag met betrekking tot deze drie competentiedomeinen wordt beschreven in *Hoofdstuk 5*.

In *Hoofdstuk 4* is de focus gericht op de tweede uitkomst van werkplekleren: welbevinden. In deze studie is welbevinden geoperationaliseerd als (gebrek aan) stress. Uit eerder onderzoek is bekend, dat op de klinische werkplek een te hoge mate van stress negatief samenhangt met prestaties en leren. We hebben Structural Equation Modelling gebruikt om verschillende modellen te analyseren voor de conceptuele relatie tussen stress enerzijds en de studentkenmerken reflectie en zelfregulatie anderzijds. Het onderzoek betreft een gezamenlijk project van faculteiten in Scandinavië (1010 studenten) en Nederland (129 studenten). Voor de Scandinavische en Nederlandse steekproeven werden

vergelijkbare verbanden gevonden. Van de modellen – die op basis van de literatuur plausibel leken – paste het recursieve model (waarin alle variabelen zowel oorzaak als gevolg van elkaar zijn) het best bij de data. In dit model stonden stress, reflectie en zelfregulatie in wisselwerkend verband. Daarbij was de relatie tussen stress en zelfregulatie duidelijk sterker dan de andere twee relaties (β-coëfficiënt -0.48 vs -0.02 en 0.10). Uit eerder onderzoek is bekend, dat zelfregulatie aan te leren is. Onze resultaten impliceren dat coassistenten die een overmaat aan stress ervaren, baat zouden kunnen hebben bij een dergelijke training.

Naar aanleiding van de resultaten van de studie in *Hoofdstuk 3* vermoedden wij, dat het leergedrag van coassistenten bij het ontwikkelen van vaardigheden en professioneel gedrag anders is dan bij het opdoen van kennis. Het doel van de studie beschreven in *Hoofdstuk 5* was daarom een zo volledig mogelijk overzicht te krijgen van leergedragingen die coassistenten gebruiken om kennis, vaardigheden en professioneel gedrag te ontwikkelen. Een deel van de leergedragingen – die uit de 13 interviews naar voren waren gekomen – werden alleen gerapporteerd voor kennis, vaardigheden of professioneel gedrag. Het grootste deel van de leergedragingen werd voor twee of drie van deze competentiedomeinen genoemd.

Het totaal van alle gerapporteerde leergedragingen was beter te onderscheiden in actief leergedrag en passief leergedrag. Actief leergedrag omvatte de subthema's zelfstandig kennis vergaren en initiatief nemen in de klinische praktijk. Passief leergedrag omvatte de subthema's ontwijken, wachten om betrokken te worden bij de klinische praktijk en leren via verplichtingen. Een tweede onderscheid dat voor alle gerapporteerde leergedragingen gemaakt kon worden, betrof de mate waarin de student de leeromgeving moest betrekken bij het leren.

Deze resultaten, in combinatie met de uitkomsten van eerdere studies over het leren in coassistentschappen en gangbare theorieën over werkplekleren, vormen de basis voor het ontwikkelen en valideren van een vragenlijst waarmee het leergedrag van coassistenten gemeten kan worden (*Hoofdstuk 6*). De vragenlijst is ontwikkeld om de activiteit van studenten op twee schalen te meten: interactief leren en zelfstandig leren. Deze indeling in twee schalen werd bevestigd door middel van een confirmatoire factoranalyse (n=253, Cronbach alfa's respectievelijk 0.68 en 0.60). Aan de hand van de definitieve vragenlijst konden in een tweede onderzoek vier leerstrategieën worden onderscheiden – gebaseerd op de neiging van de student om 1) actief de interactie met de

leeromgeving aan te gaan en 2) gedreven te zijn met betrekking tot zelfstandig leren. Deze vier leerstrategieën waren: actief werken in de leeromgeving en weinig gedreven bij zelfstandig leren (15%), actief werken in de leeromgeving en gedreven bij zelfstandig leren (34%), het werken in de leeromgeving ontwijken en weinig gedreven bij zelfstandig leren (29%) en tot slot het werken in de leeromgeving ontwijkend en gedreven bij zelfstandig leren (21%).

In het laatste *Hoofdstuk* (*7*) wordt het geheel van de studies opnieuw beschouwd in relatie tot bestaande literatuur. We concluderen dat actief leren in de coassistentschappen gestimuleerd moet worden. Enerzijds, omdat meer reflectie en meer zelfregulatie (beiden zijn aspecten van actief leren) samenhangen met verminderde perceptie van stress. Anderzijds, omdat coassistenten in de interviewstudie rapporteerden dat een actieve houding leidde tot een groter en meer gevarieerd aanbod aan leerervaringen op de werkplek. Uit eerder onderzoek is bekend dat de prestaties op de werkplek samenhangen met zowel de hoeveelheid stress als de hoeveelheid en diversiteit aan ervaring. Daarom verwachten we dat actief leren zal leiden tot betere prestaties. Actief leren wordt in de resultaten van onze vragenlijst weergegeven door een hoge score op zowel interactief als op zelfstandig leren. De nieuwe vragenlijst lijkt

dus goed bruikbaar voor nader onderzoek naar actief leren in coassistentschappen.

DANKWOORD

Toen ik afstudeerde wist ik één ding zeker: ik zou gaan promoveren. Hoe ik dat voor elkaar moest krijgen wist ik niet, maar het leek me de leukste baan in de wereld. Twee jaar later had ik de droom bijna opgegeven, toen ik alsnog de kans kreeg. Het resultaat ligt voor u, op de voorgaande pagina's. De weg naar dat resultaat toe is langer en moeilijker geweest dan ik vooraf verwacht had en ik voel me dan ook bevoorrecht dat ik steeds mensen om me heen had die me steunden. Zonder hen was dit proefschrift er niet geweest en daarom wil ik deze mensen hier bedanken.

Op de eerste plaats mijn promotores: Janke Cohen-Schotanus, Jan Kuks en Jan Borleffs. Janke, je gaf mij het vertrouwen dat ik dit project zou kunnen voltooien. En op de momenten dat ik betwijfelde of ik dat vertrouwen wel waar zou kunnen maken, gaf je me de steun die ik nodig had om door te gaan. Jan K., ik ben je dankbaar voor de term 'weerbarstig proefschrift' en voor het steeds weer doorvragen. Het proefschrift dat zo weerbarstig was om te schrijven, is door jouw vragen een stuk minder weerbarstig om te lezen. Jan B., zoals je zelf zegt, mijn begeleider op afstand. Gelukkig kon ik

altijd bij je terecht als het nodig was. Mijn vakantie werd er eens door gered.

Ook de leden van de beoordelingscommissie wil ik graag bedanken. De hoogleraren Brand, Scheele en Snoek behoren tot het selecte gezelschap dat alle hoofdstukken van dit proefschrift geheel gelezen heeft. Daarnaast kreeg ik uitgebreide feedback, zodat de laatste puntjes op de i kwamen voordat het boekje zijn finale vorm kreeg. Bedankt!

Drie van mijn mede-auteurs komen van buiten het OWI. Jullie officiële erkenning blijkt uit de auteurschappen van de verschillende artikelen, maar doet geen recht aan het werk dat er verricht is. Roy: dank je voor je onmisbare, en soms ongrijpbare, statistisch advies, onder andere in de G-club. Misschien kan ik wel verzinnen dat het zou moéten kunnen, maar jij kúnt het doen! Jan Willem: hoe vaak jij voor mij op en neer bent gereisd tussen Diepenveen en Groningen weet ik al niet eens meer. Hoewel we altijd gefocust waren op de onderzoeksvraag, hebben we ook regelmatig fijne gesprekken gehad over Overijssel en over de dingen die het leven de moeite waard maken. Peter: als alle feedbackgevers zo subtiel,

moeite waard maken. Peter: als alle feedbackgevers zo subtiel, complimenteus en vriendelijk zouden zijn als jij, dan hoop ik op nog heel veel 'advocaten van de duivel' in mijn leven. Zo werd het volledig reviseren (en nog eens, en nog eens...) van een artikel toch nog een genot.

Om het dagelijks leven van een promovendus aangenaam te houden zijn niet alleen je begeleiders, maar ook je collega's enorm belangrijk. Ik wil het hele OWI daarom ontzettend bedanken voor de goede sfeer, de steun en de feedback in de afgelopen jaren. Een bijzonder woord van dank voor collega's (van binnen èn buiten het OWI) met wie ik het meest intensief samengewerkt heb.
Johanna, je bent altijd alert en ziet alles wat verbeterd kan worden. Daarnaast heb je me ook heel vaak weer weten te motiveren, doordat je de tijd nam om te vertellen dat jij dezelfde problemen had ondervonden (en opgelost!) tijdens jouw promotietraject.
Hanke, jouw opmerking 'helder', bij de methode die mij de meeste moeite koste om op te schrijven, is het mooiste compliment dat ik tot nu toe gekregen heb.

Tineke, om te beschrijven wat jij de afgelopen jaren allemaal gedaan hebt, vergt een boekwerk op zich; je kunt jou wel bijna mijn vierde begeleider noemen. Ik blijf me erover verwonderen hoeveel mijn volledig uitgedachte stukken onder jouw hoede nog kunnen verbeteren, dank daarvoor!
Ally, we zijn tegelijk begonnen aan een promotietraject en jij bent zo hard gegaan dat je al lang klaar bent en aan een nieuwe baan begonnen. Ik heb genoten van je nuchtere houding in de tijd dat we als kamergenoten en medeonderzoekers optrokken. Je tips over het afronden van een proefschrift zijn goed van pas gekomen.
Marjolein, in de tijd dat ik dit boekje schreef, heb ook jij dat van jou afgerond. Ik wil je bedanken voor het meelezen en -denken, maar bovenal voor je hartgrondige optimisme. Met recht een inspiratie.
Anja, als ik het ooit waagde om op de vraag 'hoe gaat het met je?' een werkgerelateerd antwoord te geven, dan was jij er om me te corrigeren. Wat ontzettend fijn om een kamergenoot te hebben die elk stressmoment in het juiste perspectief weet te plaatsen.
Leo, de studenten van wie jij mentor/tutor bent geweest, mogen zich gelukkig prijzen met iemand met zoveel geduld

en zo'n breed blikveld. Dank je wel dat ik daar ook met enige regelmaat van heb mogen profiteren.
Janet, bedankt voor de waardevolle gesprekken over het werk die soms uitmondden in waardevolle gesprekken over het leven.
Wouter en Niels, jullie aanstekelijke enthousiasme voor de wetenschap heeft bij mij in mijn (soms pittige) laatste jaar het vuur brandend gehouden. Veel succes met jullie eigen proefschriften!
Tessa en Nienke, bedankt voor het luisterend oor, de gezelligheid op de kamer en soms wat vrouwelijk tegengas tegen 'onze' jongens.
Paul, ook gepromoveerd bij SHARE en medelid van de G-club. Deze club heeft me door een van mijn moeilijkste analyses heen geholpen. Ook dank voor de motiverende woorden daarna!
Ook collega-promovendi van het NVMO-promovendinetwerk mogen hier niet vergeten worden, in het bijzonder diegenen met wie ik een paar promovendidagen voorbereid heb. Monica, Bas, Stephan, Mariska, Lia, Karen, Els, Esther en Leen: bedankt voor het delen van jullie ervaringen en voor heel veel lol!

Ook heel veel dank aan iedereen die ervoor gezorgd heeft dat onze onderzoeken konden worden uitgevoerd: van studenten en docenten tot de diverse medewerkers van de deelnemende ziekenhuizen. Dank voor jullie tijd en voor het vertrouwen dat jullie gegevens in goede handen zijn. Zonder jullie was dit proefschrift er nooit gekomen.

Een proefschrift 'bouwen' kan niet zonder een solide basis. Die basis wordt voor mij gevormd door mijn familie en vrienden en daarom verdienen ook zij een plekje in dit proefschrift.
Om te beginnen mijn paranimfen, waar basis en proefschrift elkaar ontmoetten: vriendin Marloes en zusje Shira. Toen het proefschrift dan eindelijk naar de leescommissie was, bleek dat er ook daarna nog van alles geregeld moest worden. Ik ben jullie enorm dankbaar voor de steun in deze tijd en voor alle tips die jullie voor me hadden. Het is mijn feestje gebleven, maar zonder jullie was er geen feestje geweest. Daarnaast uiteraard dank voor de manier waarop jullie al heel lang en helemaal op je eigen manier deel van mijn leven zijn.

Oma Dijkslag en oma Van Lohuizen, wat fijn dat jullie altijd weer vol belangstelling vroegen (en soms zelfs voor de buren opschreven!) wat ik nou toch ook alweer deed. Direct daarna vertelden jullie me dan hoe het met iedereen in de familie en in de buurt ging. Bedankt dat jullie me op die manier altijd herinneren aan waar ik vandaan kom en waar zo'n proefschrift eigenlijk past in het grote geheel.

Pap en mam, hoewel het altijd duidelijk was dat we niet heel ver door hòefden te leren, werden nieuwsgierigheid en (veel) lezen thuis altijd gestimuleerd. Verder heb ik van jullie (en Goos en Anneke) geleerd dat je àltijd opnieuw kunt beginnen, ook als alles tegen lijkt te zitten. Drie dingen die ik als promovenda regelmatig nodig heb gehad, bedankt daarvoor!

Tamara, mijn 'kleine' zusje met een groot gevoel voor recht, onrecht en vooral het ondersteunen van je familie. We weten allebei, soms is het enige wat je hoeft te vragen: 'Want an orange?' Bedankt!

Niels, toen een van je docenten jou vertelde dat de sociale wetenschappen de echte 'hard sciences' zijn, geloofde je het niet. Tot er in mijn laatste jaar regelmatig massages nodig waren om de spanning te ontladen… Die massages gaf je, met veel liefde. Intussen ben je zelf aan het promoveren en ik hoop

jou net zo te kunnen steunen. Laten we zeggen: bedankt en… meer thee!

Voor al mijn goede vrienden: er zijn periodes geweest waarin ik jullie wat verwaarloosd heb, maar als ik een luisterend oor nodig had of gewoon voor de afwisseling eens lekker samen wilde eten, kletsen en leuke dingen doen, dan waren jullie er. Dat houdt het leven van een promovenda aangenaam. Bedankt! In het bijzonder Aline, Claudia, Egbert, Marloes, Jenny, Johanna, Froukje, Alwin en Jolanda. To my international friends Marlene and Jorge: thank you for your support, any PhD-candidate needs friends for a (very welcome) change of subject now and then. Keep sending those messages and jokes, even if sometimes I don't answer them!

Soms heb je als promovenda rust nodig om je onderzoek in een breder perspectief te plaatsen. Ik heb deze rust voor een belangrijk deel gevonden in 'De Fontein'. Vrienden, voorgangers en vrijwilligers: jullie herinnerden mij er steeds weer aan dat je de zin van het leven meer met het hart dan met het hoofd onderzoekt. Ook hartelijk dank voor de

moeilijke periodes, waarin ik me altijd welkom en gedragen heb geweten.

Sinds een paar maanden werk ik bij mijn nieuwe leukste baan ter wereld. Ik ben de collega's daar dankbaar dat ze mij gestimuleerd en mentaal gesteund hebben bij de laatste loodjes.

Als allerlaatste, voor iedereen die ik per ongeluk toch nog vergeten ben: mijn geheugen is helaas beperkt, maar mijn dank is groot.

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